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1881 contained	28	different	adv'ts.	1889 "	234	"	"
1882 "	45	"	"	1890 "	289	"	"
1883 "	63	"	"	1891 "	325	"	"
1884 "	82	"	"	1892 "	316	"	"
1885 "	100	"	"	1893 "	317	"	"
1886 "	138	"	"				
1887 "	154	"	"				

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The World's Fair. THE gratifying increase in paid admissions to the World's Fair during the past two weeks has removed a cause for some uneasiness as to the financial outcome of the exhibition. The decision in favor of Sunday opening may keep some of the puritanically inclined away, but the increased receipts on that day will probably more than compensate for these, though the gains of vicious resorts outside of the grounds will undoubtedly be curtailed. It is hoped that the electrical fountains will soon be able to take the place for which they were designed—the feature of the exhibition—when the crowds attracted by them at night will still further augment the receipts, and the electrical side of the Fair will have a reproach removed that from the magnificent showing it has otherwise made is annoying, to say the least.

A Great Electric Traction Syndicate. CONSIDERABLE interest has been created in street railway, financial and political circles by the recent great growth of the Consolidated Traction Company, operating principally in New Jersey. Almost all of the electric roads in the vicinity of Newark, Jersey City and other towns in the same district have been absorbed, and admiring city and town governing bodies have been lavishing franchises on this enticing corporation with such a free hand that threats of an intention on the part or the Governor of the State to interfere had to be resorted to, it is said, in order to get a slight return to the people for the valuable privileges granted. Among the rumors are that a recent deal is evidence that the same company intends to also enter the electric lighting field; that the syndicate operating so largely from Camden north will finally join hands and lines, and that the Pennsylvania Railroad is in the scheme. Whatever truth there may be in any of these rumors, it is evident that the great growth of the new electric traction industry furnishes a favorable field for combinations, and that the same system of consolidations may be expected to gradually take place in all important centres of the United States.

An American Engineering Laboratory. THIS week we give an account of the new engineering laboratory of the University of Pennsylvania, which offers a comparison with those of European technical schools that we have described in recent issues and others of which will appear in future numbers. It will be noted that the object of the laboratory is stated to be to turn out engineers, not electricians and machinists, from which it may be inferred that the laboratory work is intended to be illustrative of principles taught in the class room rather than exercises in the manual operations of the practical work of a profession. A notable feature of the method pursued in its laboratory instruction is that which allows the student liberty of action in carrying out his experiments and investigations, his originality not being kept in constant check by well meant but misdirected interferences of instructors. The motto of one of the great universities of Europe is that it does not instruct but educates, and in its laboratories a student may complete his course without once being spoken to by an instructor, unless assistance is asked. In this laboratory concise directions for tests are hung on the wall near the instruments to which they refer and the student may take these up in the order he pleases, vary the methods pointed out if he chooses or occupy himself entirely with original work; he can, of course, refer to the instructors for information when he thinks necessary. As a result of this system the laboratory referred to has turned out many of the great physicists of the world, and it is gratifying to know that American engineering schools are approaching the same system and avoiding the primary school methods of instruction that have so strongly characterized our college work in the past.

Averages and their Fallacy. ONE of the great labor saving devices of the editorial sanctum and of the mediocre writer on economics is that of averages. When a subject is complex and the different factors require a laborious weighing to determine their resultant effect, it is so easy to call in the aid of "the happy mean," or to strike an average, that sometimes the temptation is almost irresistible to adopt this time-honored and usually safe method of retreat, which often by a brave air may even be given the appearance of an advance. In most cases, particularly in editorial writing, the reader will be entirely justified in considering that this is a device adopted as an easy way out of a difficulty. In certain branches of statistics it must be admitted that the average is a legitimate recourse, but this is because the difficulty of the case may not admit of other treatment or method of comparison, or that the variations are such as to permit the proper application of the arithmetical mean. For theoretical purposes, however, and, in quite as great a degree, for practical purposes, the average should only be relied upon in the absence of everything else. In science the method of least squares, which may be denominated a scientific average, where applicable, reigns supreme, and in everyday life questions are decided on their own merits without reference to the average solution. In fact, it may be said that the successful man becomes so by the avoidance of averages, of which even nature herself seems to have an abhorrence. The statistician will gravely inform the public that the average wages paid in a certain industry are much below those in another, implying that the latter therefore offers superior advantages to workmen, while in point of fact each grade of labor may be much more highly compensated in the former, and the difference in the average caused by the larger proportion of unskilled labor employed. When applied to engineering operations, nothing is more dangerous from a business point of view than dependence on the average; the average cost per horse power of water power, steam or electrical machinery, and the numerous other tables of approximate information are often worse than useless, as an estimate based upon them alone will in most cases be either too high and thus cause the loss of a contract, or, what is worse, be too low and cause a direct financial loss. The variation in cost due to quantity, quality, labor and other particular conditions of any case are so great that if the means are not at hand for an estimate based upon exact figures, in many, perhaps most, cases it will be better to avoid making any at all unless there is a desire to include the element of speculation. In this age, when everything is becoming specialized and individualized, and when keen effort is always searching for the advantage to be derived by a departure from average conditions, success depends entirely upon careful scrutiny of details and the strict co-ordination of the special facts of each case under consideration.

Increase of Drop in Alternating Current Conductors. IN almost all works in which the increased drop in conductors carrying alternating currents is referred to, the increase over that due to a corresponding continuous current is ascribed to the increase in resistance following from the unequal distribution of the flow of the alternating current in the cross section of the conductor. This, of course, is entirely wrong, as the effect of the unequal distribution is entirely negligible with the sizes of conductors and the frequencies used in practice, amounting to only about one-twentieth of one per cent. in a 000 B. &. S. copper wire with a frequency of 130 per second. With very great frequencies this factor becomes large, yet the resistance of a 000 B. & S. copper wire is only doubled at 10,000 periods per second. The real cause of the practical drop is impedance, and this Mr. A. E. Kennelly has recently exhaustively investigated for different frequencies and different sizes of wire, the results being given in a paper in the April and May numbers of the Transactions of the American Institute of Electrical Engineers. Taking the same wire mentioned above the increase in drop due to impedance with 130 frequencies would be in concentric conductors about 30 per cent; with conductors separated a distance of 10 inches the drop is more than quadrupled, while for a single conductor suspended twenty feet from the ground it becomes more than six times as great as when carrying a continuous current. With a No. 6 B. & S copper wire this increase is insignificant in a concentric cable, only 25 per cent. when the conductors are separated ten inches and 70 per cent. for a single conductor under the conditions given above. In long lines having considerable capacity these results are considerably modified but hold true for ordinary lighting circuits. It will be interesting to note the cause of the increase of resistance in each of the two cases referred to. To assist in conceiving of the action within a straight cylindrical conductor carrying an alternating current, we may imagine the whole current to consist of an infinite number of component currents. First consider the increase of resistance due to unequal distribution of current in the cross section of a conductor. Owing to the constant change in the value of these filamentary currents, each exerts an inductive effect on, and is subjected to inductive action from, all others within the conductor. The central filamentary current, however, having a less mean distance from the other currents, is subject to the greatest action, and a current on the surface of the conductor, having a greater mean distance, to the least. As the result of this mutual induction is to set up counter electromotive forces, less current will therefore flow through the centre of the wire and more near the surface, and the greater the rate of alternation the greater will become this disproportion. The consequence of this unequal distribution and resultant greater density near the surface is that the resistance to the passage of the current is increased, following Ohm's law. For example, suppose we have a conductor of a resistance of one ohm; imagine this conductor to consist of a central core and a surrounding cylinder of equal area, each having thus two ohms resistance. Now suppose that the rate of alternations of a current of three ampères passing through the conductor is such that one ampère passes through the central, and two ampères through the cylindrical, part. If the current were a continuous one the energy lost through resistance would be $3^2 \times 1 = 9$ watts; in the assumed case, however, the energy lost will be $(1^2 \times 2) + (2^2 \times 2) = 10$ watts, and as the currents flowing are equal in the two cases the resistances will be in the ratio of the watts, or as 9 : 10; in other words, the conductor will have a real increase of resistance of about 11 per cent. due to crowding the current into a smaller area. It should be noted that this is not a contradiction of Ohm's law, but, instead, a result of it. The drop due to impedance, which is, as remarked before, much greater than in the case just considered, results from the fact that every circuit carrying a current is a closed loop, and the increase and decrease of the lines of force in this loop, due to the current alternating in strength, sets up a counter E. M. F., the effect of which is an apparent increase in the resistance of the conductor. The nearer together the two conductors of a circuit are the less lines of force will be inclosed by the loop and therefore the less back E. M. F. will follow from their variation. It will be seen that the increased apparent resistance due to alternating currents may become a serious factor, but by using small wires and keeping them close together the effect may easily be kept within practical bounds.

On Moral Shows, Electrical, Historical and Otherwise: A Rejoinder.

BY PARK BENJAMIN.

I have read with pleasure the reply of Mr. W. J. Hammer to my notes on the badge and his description thereof, wherein, after admitting many of the criticisms advanced, he seeks to justify as to others by quoting from a little book of mine, written some seven years ago.

Of course, if Mr. Hammer thinks that it helps him to show that at that distant period I was as ill-informed in matters of electrical history as he is now, and for exactly the same reason which he sets up as his present defense, namely, reliance on second-hand authorities, the best I then had available, he is quite welcome to do so. He certainly proves that the "Age of Electricity" ought to be corrected, a notion which I have been trying hard for several years without much success to impress upon the publishers who own the book.

But what all this has to do with the accuracy of the facts as given in my former communication, which were there plainly shown to be taken from the original authorities now in my possession (books, by the way, which Mr. Hammer has been urging me lately to let him have for public exhibition at Chicago), it is difficult to perceive. Their printed pages speak for themselves, and to dispute them on the basis of the mistakes or misapprehensions of people who wrote about them centuries later would be ridiculous in anybody but Mr. Hammer.

Besides, these books were entirely at Mr. Hammer's service for consultation before he wrote the blundering description criticised, and were open to him to verify my statements, if he thought the latter worth contradicting before he rushed again into print with his present reply. He has considered it expedient not to avail himself of the opportunity to obtain accurate information; true, at the cost of a little humbug, but in the language of a famous dramatist with notable gain in "contemporaneous human interest and dramatic effect."

I supposed, as did many others, that the description criticised was a semi-official statement of the Institute. It is pleasant to be corrected as to this, for now that we know it to be only a part of one of those delightful moral shows which its author knows so well how to make, cavil is disarmed, and we discern the refulgence of a new claim to the proud title of the Only Electrical Barnum.

That Badge, and Incidentally Some Suggestions in Regard to the Same.

BY GILBERT FRANKLIN.

There seems to exist among certain members of the American Institute of Electrical Engineers an ill-disguised antipathy to the badge recently adopted for the decoration of members of that honorable body. In view of the equanimity with which the decrees of those controlling the policy of the Institute have heretofore been received, it is a matter of no little interest to examine into the cause of the unusual irritation displayed in this case.

Of the need of a badge there can be no question, assuming that the members desire in this respect to keep in step with other engineers. The stationary engineers have their indicator card badge, the marine engineers their propeller badge, the locomotive engineers their eccentric badge, and why, it may be asked with reason, should not electrical engineers have their happy combination Wheatstone bridge, Franklin's kite, etc., etc., badge? This may be said to be the age of badges, a fact that the slightest observation, particularly in popular assemblages, will verify. On a recent trip to Coney Island the writer noticed only one man undecorated, and he was plainly regarded as a nondescript.

As to the badge itself, it may be urged that it is not inclusive enough in its symbolical character. Referring to the badge, with the aid of the official explanation, we find that, notwithstanding its moderate size, it represents Franklin's kite; insulation (a silk handkerchief); electrical history (amber); the Wheatstone bridge; wire, with incidentally an object lesson in kinks; the galvanometer and mariner's compass in one; and last, but by no means least, is the happy, I may even say profound, thought of including the symbolical representation of Ohm's law, thus giving the tout ensemble the scientific aspect and the mystic guise that should characterize the true badge, the latter feature being further accented by the balls at the angles, whose true significance is only imparted to an inner circle of adepts.

While this catalogue may seem rather lengthy, a little thought makes it at once evident that it is not sufficiently inclusive, and on this ground there is, therefore, real cause of complaint. A study of the list shows that several of the most important branches of electricity have been neglected. For example, there is carbon, of the greatest importance in the electrical arts, which might be represented by a diamond set in the amber, thus also ingeniously disposing, by implication, of both the arc and incandescent lamps; the dynamo and motor and their property of reversibility could be cleverly illustrated by duplicate miniature models pendant from two angles of the bridge, and the great importance of the alternating current neatly provided for by curving, say, the two upper wires in the form of a sinusoid; telegraphy is sufficiently represented by the dash and period of Ohm's law, and a miniature telephone suspended from the lower angle of the badge would recognize another important branch. These additions would doubtless satisfy many of the carping critics and at the same time provide further topics for the wearer of the badge to base an explanation to lay inquirers sufficiently lengthy and impressive to be worthy of his position as a member of the Institute.

I fear, however, there will yet remain a small coterie of scoffers, and of this hypercritical class the most numerous will probably be those who will feel that their distinction is threatened by the importance the badge will give to other members; I refer to the small body who, by reading papers before the Institute, have heretofore had almost a monopoly of public recognition, but who hereafter, in the eye of the lay public, will not be appreciably differentiated from the other wearers of the badge. As these gentlemen have too long had a monopoly of the honors of the Institute they will deservedly meet with little sympathy, and although they are in a sense useful, the wishes of the great majority cannot continue to be subordinated to their interests in the future as they have been in the past.

I beg to further suggest that in order to get an expression of opinion from all of the members of the Institute, and thus obtain an undoubted popular verdict for the badge, either in its present or in a revised form, a committee be appointed to send out a circular asking for views on the question. In order, however, not to introduce a new element of discord and to remove a temptation, the reply envelope should be required to be stamped and an ironclad clause should be introduced prohibiting the use of the official printed head of the Institute and other subterfuges by any person who may be attempting to substitute a badge of his own.

Currents from Commercial Circuits for Medical Purposes.

BY H. F. WAITE.

In reply to the article in The Electrical World of May 27 by Dr. Hutchinson as to putting a one-ampere fuse in circuit with the patient and so avoiding all posible danger to the patient, I would say, suppose that a doctor is removing a hair (in which case he would not use more than two milliamperes) and a 2,000 volt wire crosses the 110-volt circuit; the patient is killed and the fuse is not burned out, for the reason that there would be a resistence of 55,000 ohms in the circuit. According to Ohm's law $\frac{E}{C} = R$ 110 volts divided by 2 milliamperes equals 55,000 ohms, so that to burn out the one-ampere fuse it would require 55,000 volts.

Suppose that a doctor is using 250 milliamperes at 110 volts and his fuse is set to burn out at 500 milliamperes; the electromotive force will have to rise to 220 before the fuse will burn out. And right here I want to call attention to the following very important fact which has been overlooked in all replies; while the increase to 220 volts of itself might not do any harm, the shock at the break of the circuit would in many cases cause nervous prostration.

In reply to the letter of Mr. C. Doutre in The Electrical World of June 10, I would say that if he has found a way to so reduce the resistance of the body that he can get 250 milliamperes at one volt, he has certainly made a very important discovery, and one that will be greatly appreciated by the profession, as the resistance is usually from 200 ohms up, in cases in which so large a current is used. According to Mr. C. Doutre, he reduces the resistance to 0.4 of an ohm and so gets 250 milliamperes at one volt. I suppose he reduces the resistance from hand to hand in the same way as he takes a current of 27 milliamperes at 18 volts. The resistance from hand to hand varies from 2,000 to 5,000 ohms, so that any except Mr. C. Doutre would require from 54 to 135 volts to get that current. Probably most of the readers have not tried to pass 27 milliamperes from hand to hand, but I think that a trial will satisfy them that from 10 to 15 is about all they want. According to Mr. C. Doutre, his own apparatus is not safe, as he says in his letter: "Now, put these instruments in the hands of a person who did not know how to use them and he in all probability would get such shocks as would make him firmly believe to his dying day that there is a danger in using currents from commercial circuits." As every one is likely to make a mistake, the apparatus as manufactured cannot be perfectly safe, and I do not believe the reader would be willing to allow Mr. Doutre to use electricity from the street circuit on him, because if Mr. Doutre made a mistake the patient would be shocked so that he would not forget it to his "dying day." I do not think that Mr. Doutre's remarks in regard to the knowledge of electricity by battery makers are in very good taste, especially as he is a manufacturer of apparatus for use with the street circuit. It will also be noticed that Mr. Doutre says that the street current is perfectly safe, provided the instruments are first-class and the parties using the same thoroughly understand them, due precaution, of course, being taken. It is clear from the above remark that a great danger exists in using the street current; otherwise why the frequent cautions in Mr. Doutre's letter. If the instruments are first-class and due precaution is used, an accident ought not to happen, but we read every day of some one being shocked, not because the instrument was not first-class or not thoroughly understood, but because due precaution was not taken. It is not when the doctor has just bought the instrument that an accident is likely to happen, but after he thoroughly understands it, as he then gets careless.

Charges Against an Ex-Commissioner of Patents.

In the disbarment proceedings last week before the Commissioner of Patents against ex-Commissioner Simonds, and Foster and Freeman, Mr. Simonds, by his act torney, admitted that there had been made for him, and later, when called to the stand, he produced certified carbon copies of seven different sets of papers in the Daniel Drawbaugh files, among which was the file and contents of the original application of Drawbaugh of 1880. It is contended by Church & Church, who are conducting the prosecution on behalf of the government, that this application is the original out of which a large number of pending divisional applications were carved, the most important of which was that of April 3, 1884. It is further contended that the disclosure of the contents of this parent application was in fact a disclosure of the contents of that of 1884, which is admitted to be a live application still pending. Among the other copies of Drawbaugh papers which Mr. Simonds produced was a certified copy of the public use proceedings under the application of 1884, which Church & Church contend is a part of the 1884 application, and, therefore, presumably in the secret files of the office. Some two months after he became Commissioner of Patents there came before him, by regular appeal from the lower tribunals of the office, the question whether the application of Daniel Drawbaugh for improvements in telephones, filed April 3, 1884, was barred by reason of public use and sale of the Edison microphones for more than two years prior to the filing of the Drawbaugh application of April 3, 1884. On Oct. 28, 1891, he decided that the statutory bar existed; and that decision was published in the "Gazette" of Nov. 3, 1891.

The next day after rendering the decision, to his surprise, Mr. Simonds said the examiner in charge of the proper electrical division reported to him in writing upon the status and condition of the application of Emil Berliner for patent on telephones which had been pending in the Patent Office since 1876. It appeared therefrom that in the regular course of events in the office the Berliner application was then ready for issue, and had been ready for issue for some years, except for a threatened or possible interference with this Drawbaugh application over the question of priority of invention, in case the Drawbaugh application had been victorious upon the question of two years' public use; but as the Drawbaugh application had been killed, so far as the Patent Office was concerned, by his decision about the existence of the statutory bar of two years' public use, it was no longer a possible interference contestant. Upon that report he treated the Berliner application like any other and ordered it to issue, and it did issue Nov. 17, 1891, to the American Bell Telephone Company, the assignee of Emil Berliner. About a year had elapsed, when one day the Attorney-General of the United States (Mr. Miller) called upon him and said he had under consideration the project of bringing a suit in the name of the government to repeal and annul the Berliner patent of Nov. 17, 1891, and gave an opportunity for the expression of any opinion which he (Mr. Simonds) might choose to make. He told the Attorney-General that he had no opinion about it to express; that when he issued the Berliner patent he performed and finished his duty in the premises.

Moonlight Table for July, 1893.

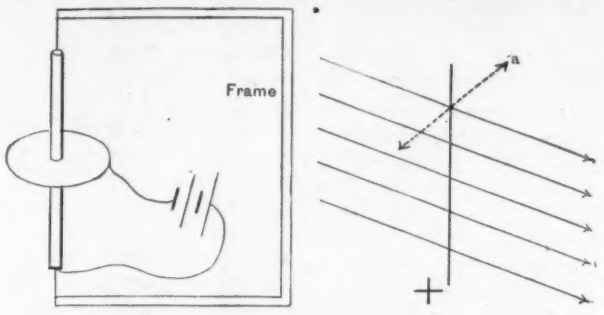
Herewith we give Mr. H. W. Frund's table of lighting hours for the month of July, under his modified form of moonlight schedule:

TABLE NO. 1. Standard Moonlight. Philadelphia System.				TABLE NO. 2. Frund's New Moonlight System.			
Date.	Light.	Date.	Exting.	Date.	Light.	Date.	Exting.
1	8:00 P. M.	1	10:40 P. M.	1	8:00 P. M.	1	10:40 P.M.
2	8:00	2	11:10	2	8:00	2	11:10
3	8:00	3	11:30	3	8:00	3	11:40
4	8:00	4	11:50	4	8:00	4	12:00
5	8:00	6	12:20 A. M.	5	8:00	6	12:20 A.M.
6	8:00	7	12:50	6	8:00	7	12:40
7	8:00	8	1:10	7	8:00	8	1:10
8	8:00	9	1:40	8	8:00	9	1:40
9	8:00	10	2:20	9	8:00	10	2:20
10	8:00	11	3:10	10	8:00	11	3:40
11	8:00	12	3:40	11	8:00	12	3:40
12	8:00	13	3:40	12	8:00	13	3:40
13	8:00	14	3:40	13	8:00	14	3:40
14	8:00	15	3:40	14	8:00	15	3:40
15	8:30	16	3:40	15	8:00	16	3:40
16	9:00	17	3:40	16	8:00	17	3:40
17	9:20	18	3:50	17	8:00	18	3:40
18	9:40	19	3:50	18	8:00	19	3:50
19	10:00	20	3:50	19	8:00	20	3:50
20	10:20	21	3:50	20	8:00	21	3:50
21	10:40	22	3:50	21	8:00	22	3:50
22	11:00	23	3:50	22	8:00	23	3:50
23	11:20	24	3:50	23	8:00	24	3:50
24	11:50	25	3:50	24	8:00	24	12:00 M.
25		26	3:50	25	8:00	25	12:00
26	12:20 A. M.	27	3:50	26	8:00	26	12:00
27	1:20	28	No light.	27	8:00	27	12:00
28	No light.	29	No light.	28	8:00	28	12:00
29	No light.	30	9:50 P. M.	29	7:50	29	12:00
30	7:50 P. M.	31	10:00	30	7:50	30	12:00
31	7:50			31	7:50	31	12:00
Total hours' lighting, 143.50.							

Fundamental Laws in Electro-Dynamics.

BY B. B. JAMES.

For the explanation and determinations of the mutual dynamic action of currents and magnets, all our text-books give rules and mnemonics in confusing array. We have the three "laws" of Ampere; the general law of Ampere's "Tables" that closed circuits tend to set themselves in such a position that they will include the greatest possible number of lines of force threading them in the positive direction; for the case of a vertical current movable about an axis parallel to but not coinciding with its own, the mnemonic that it will turn till the current runs down on the east side; for a horizontal current we have another rule, and for a magnet forming a part of a circuit we seize on some one motion, and, remembering this case, we refer all other similar (!) cases to it as to a rule of thumb. Combinations of a vertical element with a horizontal may move either way to stable equilibrium, may revolve continuously or may not move at all, and what happens in a particular case is usually, even in the earth's uniform field, a Chinese puzzle for students. Ganot's "Physics," a popular school textbook, devotes twelve or fifteen pages to these actions, and gives over a dozen italicized rules for the mystification of the reader. Neither do I know of any book in which the cases are simplified. In the ninth edition of the Encyclopaedia Britannica, Professor Chrystal gives the case of a magnet pivoted vertically (Fig. 1.), with a disc rigidly fixed to its centre concentric with it; a brush carries a current to the disc's edge, whence it runs to the bottom, say, of the magnet, thence to the battery. Suppose the N pole of the magnet is above, how does it move? Professor Chrystal advises us to consider this first as a generator; for if we attempt to say which way it will move as a motor, we will likely have to "guess again!" but he can give us an easy way to remember if we begin as if the device were a generator.

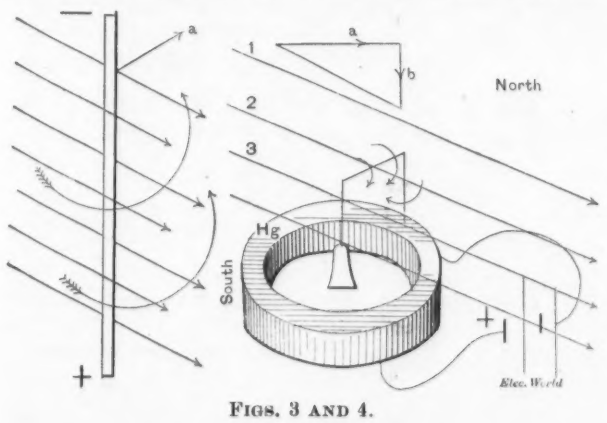


FIGS. 1 AND 2.

The result of all these statements of the laws of the dynamic actions of currents is that if you ask an electrical student what motion will result in a particular case he hesitates and hunts around for the "rule" that applies for the case, and in the end, for difficult cases, you would likely get different statements from any two persons you chance to ask.

The extreme difficulty of making students remember these cases, and, to be candid, of remembering them myself from year to year, led me to look for some fact in common in all these apparently special cases that I could seize upon and refer every possible case to as to a fundamental principle.

The only general law applying to these cases I have seen in our schoolbooks is this: Any conductor (Fig. 2) carrying a current in a magnetic field other than its own tends to move at right angles both to itself and that component of the field normal to itself. The only trouble with the law is that it does not tell us which way the conductor tends to move. It may move up or down, east or west, or in either of any other two directions so far as the law states. An examination of the motions under consideration shows that the laws should be amended by: "and towards that side on which its own lines of force and those of the field tend to go in opposite directions." (Fig. 3.) This addition makes the law explain all these dynamic actions and reduce all the "laws" to one.



FIGS. 3 AND 4.

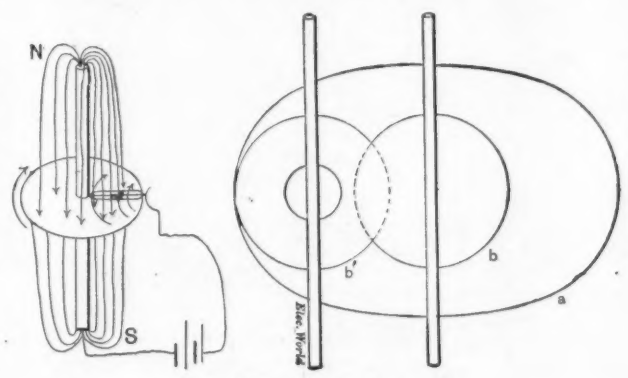
The application of the law thus stated makes evident the cases covered by Ampere's laws and those illustrated by Ampere's "Tables." Let us take the more complex case, Fig. 4, or a circuit having a horizontal element and a contiguous vertical element. Let the current flow from left to right as you look down upon it, and let the conductor be pivoted at the left. This element is affected, of course, only by the vertical component of the earth's magnetism. An application of the law shows that the conductor will tend to revolve around its pivoted end counter clockwise in whatever position it is placed. The law that the lines of force are circulated around the wire (due to the current) as the twist is to the thrust of a screw is, of course, to be applied; and we are speaking of the northern hemisphere. Consider now the vertical element of the current which is on the end of the horizontal element that is free to move. Only the horizontal component of the earth's magnetism affects this element. Apply the law when the current in the horizontal element is flowing north. The earth's component tends to move the vertical element to the east, while the earth's vertical component has been found to push the horizontal current to the west (Fig. 4). If we apply the law at a position 180° from this, the two elements tend to go in the same direction, viz., east. If the current is running to the west the wire is in a position of unstable equilibrium so far as its vertical element is concerned, and if the current is running east the position will be one of stable equilibrium so far as the vertical element affects it.

Whether, therefore, the system starts in any position, and, if it starts, whether it will find a point of stable equilibrium or not, will depend on the comparative magnitude of the two components of the earth's magnetism and the relative length of the horizontal and vertical elements of current that are free to move.

Take the case referred to as being mentioned in the Encyclopaedia Britannica; say the contact is to the right as you look down upon the disc (Fig. 5). The lines of force from the current tend to come up on the side near you; on the same side those from the N pole tend to go down; hence the conductor, a radial element of the disc in this case, tends to approach you, and the disc will carry the magnet with the watch hands.

The converse of the amended law concerning the generation of currents is obvious: The generated current has such a direction that the lines of force on the side toward which it is advancing are in the same direction as those of the influencing field.

Why should the wire move toward that side on which the lines of force tend to go in opposite directions? Consider Faraday's notion of magnetism as developed by Maxwell—rotation of ether masses, we may say, on axes coincident with the directions of the lines of force, and producing a lateral compression at right angles to these directions as revolving fluid spheres become spheroids, bulging out at their equators. Lines of force cannot go, in the same space, in opposite directions. They cannot glide past one another or through one another. If they act throughout the same territory they produce a resultant. If they are going in opposite directions they produce a resultant equal to their algebraic sum, taking either as positive and the other as negative. If they have the same sign, are going in the same direction, they produce a resultant greater than either. The greater the number of lines of resultant force the greater the lateral strain, and when we remember that this strain is at right angles to the wire carrying the current and at right angles to the lines of force of the surrounding field we can easily see that we might look for an actual pushing of the current (Fig. 6) if this strain is greater on one side than it is on the other. But as the magnetic strain is always less on the side on which the lines of force are trying to go in opposite directions a conductor is pushed over to this side. And so it appears that though the addition to the law may seem crudely stated in the form in which I have given it, yet it is the proper statement, for it is because of this opposite direction that the lines of force have that the conductor moves to that side.



FIGS. 5 AND 6.

Consider a rectangular current, Fig. 4, free to move about a vertical axis in its own plane. It will try to place itself east and west, not because in that direction it "includes the greatest number of lines of force threading it in a positive direction," but because the down current has less pressure on its east side than on any other side, and vice versa for the up current; the down current tries to get as far east as possible and would go around the world if it could, and the up current tries to go west because it is pressed in that direction by the greater magnetic strain on its east side.

Students continually get the wrong impression from the statement, even if it is Maxwell's own, that the frame so sets itself in order to "include the greatest number of positive lines of force." We may truthfully say that the circuit objects to having so many "lines of force threading it in the same direction;" for if we had four straight frictionless wires and laid them so as to inclose a rectangle and sent a current around the circuit the wires would move away till they broke the circuit, and would do so simply because there would be so many lines of force threading the rectangle "in one direction;" which has at bottom the same explanation that successive portions of a rectilinear current repel one another.

The application of the law to motors makes intelligible, to some extent at least, why the armature revolves, and we are no longer asked to believe that the circuits of the armature have some mysterious inclination to include as many lines of force as possible. The (wires of the) armature is pushed around as truly as if we pushed them by hand. Again, in the dynamo it takes power to revolve the armature because of the same crowding of the lines of force on the side toward which the wires are advancing and neutralization of them behind the wires. Why a current is generated in the wires of the armature of a dynamo is as well set forth by Fleming, ib., as one could wish.

Such "rules" as that of Ampere of a person swimming in the current, and the one of placing the thumb, fore and middle fingers at right angles, etc., are so artificial and unscientific withal that even students look sheepish in using them, and I have found by trial in the class-room that most students apply the rule as I have stated it almost instantly to any case after one illustration is mastered.

I make no particular claim about the statement except that I have put in easy form what I suppose Maxwell considered so self-evident as to need no statement except a mathematical one, which, taken from the "cyclic order of the co-ordinates" and put in every-day language, has been reduced to the rule of the thumb and fore and middle fingers.

An explanation frequently given of parallel currents in the same direction attracting each other is that the lines of force tend to shorten because of polar contraction of the ether spheres, and the lines of force consequently act like rubber bands, as the lines of force a, Fig. 6, may be supposed to do, pulling the wires together. This would do if it were not that it does not explain "repulsion" at all, and would be difficult to apply to many cases, which might, with some difficulty, however, be explained by it.

The student who finds difficulty in understanding the phenomena as described would be materially helped by reading some good statement of Maxwell's theory as he left it, such, e. g., as is given in the first volume of Fleming's work on "The Transformer," chapter on "Dynamical Theory of Current Induction."

Electro-Chemical Effects Due to Magnetization.

In a series of investigations carried on by Lieut. Geo. O. Squier in the laboratory of the Johns Hopkins University on the electro-chemical effects due to magnetization, the following interesting results were obtained: Whenever iron is exposed to chemical action in a magnetic field there are two directly opposite influences exerted. First, the direct influence of the magenetized condition of the metal, causing the more strongly magnetized parts to be protected from chemical action. Second, the indirect influence of the magnet caused by the concentration of the products of the reaction about the more strongly magnetized parts of the iron.

This tends to produce a higher potential at the more strongly magnetized parts, and finally establishes permanent electric currents, which go in the liquid from the more strongly magnetized to the neutral parts of the iron. This concentration effect increases rapidly with the amount of iron salts present and the fluidity of the solution.

The convection currents in the liquid are themselves a consequence of this same concentration, being electro-magnetic rotations produced by the action of the magnets on the local electric currents between the different parts of the iron.

As to the permanent current, due to the magnet which is finally set up between the electrodes, it is probably due to a change in the character of the reaction produced by the concentration of the iron salts about the more strongly magnetized parts, which would tend to cause a ferrous instead of a ferric reaction to take place, and thus increase the electromotive force.

Photographing Bullets.

Dr. Bottomley before the Glasgow Phil. Soc., showed some photographs of bullets in motion, referred to in a paragraph in the Digest, April 15. Photographs were shown of a bullet in carbonic acid gas to show the slower speed of the air waves; others of a discharge of shot, and a bullet passing through a plate of glass, showing how the splinters are first splashed back when the bullet enters the glass, and after it has passed through it sucks them through the hole, carrying them with it and gradually depositing them. He mentions that Prof. Boys has shown that the duration of a spark from a Leyden jar under certain conditions was about one-twentieth of a millionth of a second.

Electricity at the World's Fair.

The natural situation of the World's Fair buildings is so picturesque and the architecture so beautiful that each new photograph or drawing possesses some additional attraction or presents the subject in some new light. The Electrical World has already published a large number of views of the grounds and various buildings by its own artist, and many other journals have given considerable attention to this line of work. In "Frank Leslie's Illustrated Weekly" of June 22, 1893, a view of

THE ADMINISTRATION BUILDING AT NIGHT.

the Administration Building, brilliantly illuminated at night, is given, and as it presents this beautiful structure from a different artistic standpoint somewhat than that of the sketches already published in these columns, it is here reproduced.

The exhibits at the World's Fair may now properly be said to be in a completed state and each day attract a larger number of curious sightseers. Among those which have an interest to the electrical fraternity the following present some attractive features.

THE JOSEPH DIXON CRUCIBLE COMPANY.

The Joseph Dixon Crucible Company is the only concern in the world which manufactures every article of which graphite is a component part. With the invention by Joseph Dixon in 1827 of the plumbago crucible, the crucible business was revolutionized. At that date began also the manufacture of Dixon's stove polish, etc.

This company has two exhibits at the Fair. One is of Dixon's American graphite pencils in the northeast gallery of the Manufactures Building, and the other, covering all the other articles manufactured by them, in the northeast gallery of the Mines and Mining Building. The pencil space occupies a space 10×14 feet. In the centre of this space stands a low mahogany table surmounted by a pyramid of velvet, which is covered with pencils arranged in graceful and beautiful designs by an artist employed especially for that purpose. Over this pyramid stands a rosewood and plate glass case. Two ornamental facades of turned and carved mahogany front the space which is separated from neighboring spaces by means of Japanese bead curtains, suspended from carved grills. The space is lighted at night by means of two gilt electroliers of six 16 c. p. lights each.

The company's exhibit of general and special graphite products in the Mines and Mining Building occupies a space 25 by 28 feet. A very handsome cherry facade fronts the space, while the sides are hung with tastefully arranged portieres. Crucibles, retorts, ladles, stopper-heads and nozzles, graphite boxes, phosphorus chargers, resistance rods and devices, incandescent filament forms and other special goods made of graphite are shown in upright cabinets. In another case is shown the development of an electrotype plate, in which process the use of graphite is an essential. In still another case are shown over 50 varieties of graphite, for as many different uses and under as many different names, such as graphite for lubricating, stove polish, foundry facings for green, dry or loam castings; core wash, ingot mold wash, shot and powder glazing, electrotypers, gilders' use, hatters' use, rubber packings, piano and organ actions, "pot-leading" yachts, for crucibles, lead pencils, paint pigment, lubricants, etc., etc.

There are also shown samples of graphite from all the principal sources from which that article is obtained. One very fine sample from the island of Ceylon weighs nearly 300 pounds.

The Dixon compny were the first to complete their exhibit and their promptness brought forth a very complimentary letter from the chief of the department.

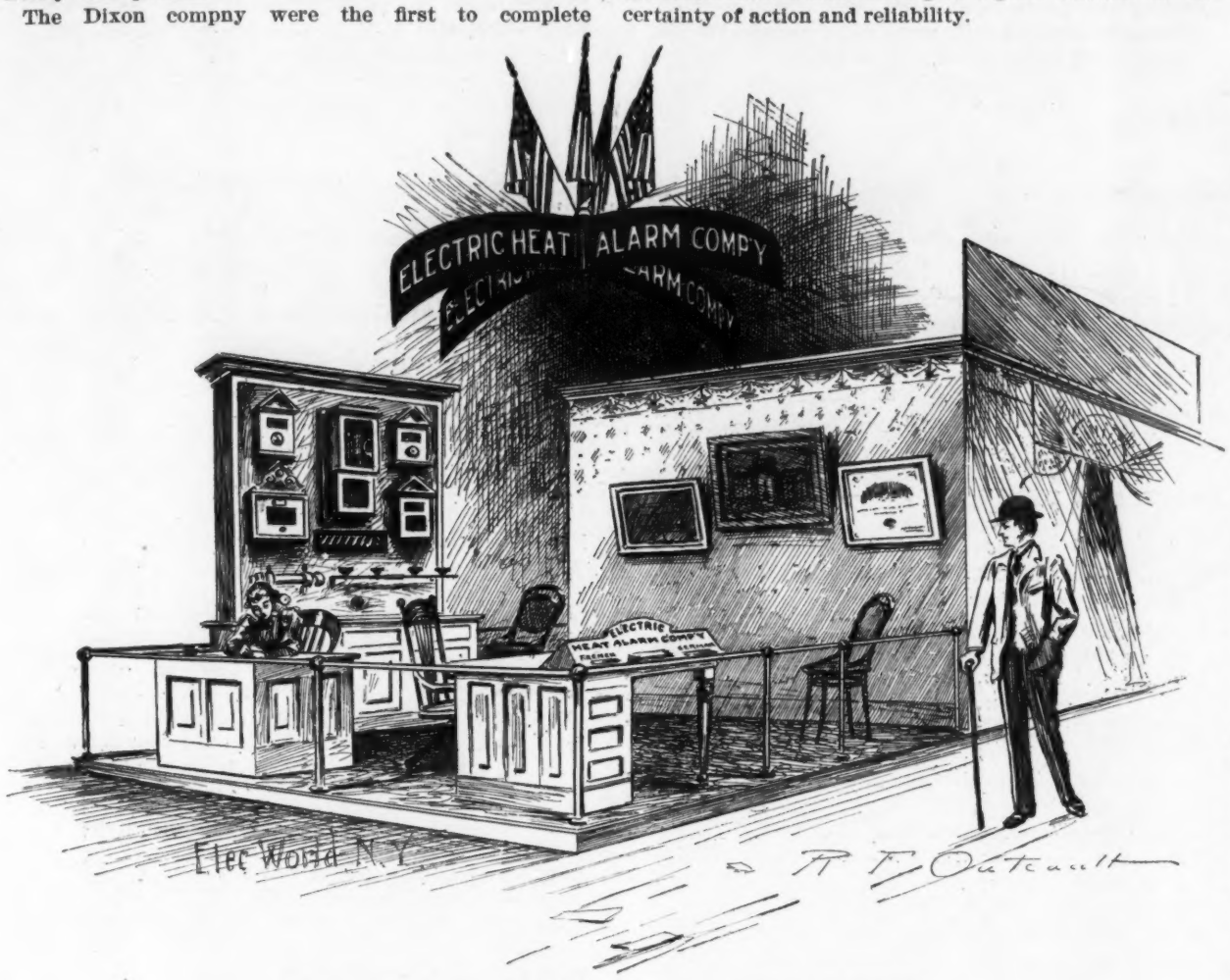


EXHIBIT OF THE ELECTRIC HEAT ALARM COMPANY.

THE ELECTRIC HEAT ALARM COMPANY.

This company display their apparatus at the extreme north end of what has become known as Newspaper Row. The apparatus itself is so unobtrusive as to readily escape notice unless one's attention is specially attracted to it. In fact, this is one of its virtues, that it may be applied wherever desirable without disfiguring the appearance of the locality. Small and insignificant as it is in appearance, the office it performs is one of the utmost importance, and it therefore deserves close attention of all those having to do with things combustible.

A system of automatic fire alarm to be of practical service needs to do more than simply give an alarm when the temperature in a building or other structure has become so abnormally high that a fire is imminent. It must do more than this.

Many a disastrous blaze and many an incipient fire might have been averted had the owner of the building or fire department been instantaneously notified of the exact point where the danger lay, and could have proceeded at once to handle the fire. That is what this system claims to accomplish, but to do this successfully the apparatus must be so simple as to be incapable of easy disarrangement. Like most other fire alarm systems, the basis of this is a thermostat. The particular thermostat here employed may be described as follows:

Into a fibre plug is inserted a glass tube, which is most firmly embedded in the plug. A Bessemer steel cup is forced on to the fibre plug under great pressure. Chemically pure mercury fills the cup, and a steel screw is permanently fixed in the mercury. An adjustable screw is set to any particular degree of temperature at which it is desired the mercury shall make contact with the same; hence it will readily be seen that the contact between the positive screw and the negative mercury is made by the rising of the latter as in the thermometer. It may be here incidentally stated that every part of this thermostat is so accurately and tightly fitted that the mercury is practically or medically sealed in the steel cup. This feature enables the thermostat to be placed on journal bearings in steamships or on other dirty and wet machinery. In this way it will be seen that the contact is made in a chamber from atmospheric contaminations. Aside from the adaptability of this thermostat to different portions of the house or factory to detect abnormal rises of temperature it finds many ready applications in other directions; not the least valuable of these are to journal bearings wherever machinery is employed. Having determined what rises of temperature above the normal are permissible on such bearings, the thermostat may be adjusted to give an alarm when this temperature is reached. As each instrument may be connected with an annunciator through its appropriate circuit, the trouble in a factory may be recognized the moment it occurs, and corrected before serious damage can have been done. The simplicity of the thermostat is such as to give a good warrant for its certainty of action and reliability.

The main offices of the Electric Heat Alarm Company are at No. 113 Devonshire street, Boston, Mass., and the display is in charge of their Western manager, Mr. E. Nashold.

THE HOPE ELECTRIC APPLIANCE COMPANY.

In the southwest corner of the gallery floor is shown a small but interesting display of appliances, which will greatly interest those engaged in the arc lighting business. It is that of the Hope Electric Appliance Company, of Providence, R. I., who show here samples of their automatic mast arms, trolley mast arms, and cut-out boxes for arc and incandescent circuits. Much of the ill-repute into which electricity has popularly come has been due to the carelessness of employees, which has resulted in their serious injury or death. Others than employees seldom come in contact with the arc light circuits, but it often becomes the duty of the trimmer or trouble man to handle the apparatus while the circuits are fully charged with their maximum potential. While stringent rules are laid down governing the conditions under which it is presumably safe to handle the apparatus when thus charged, familiarity with the danger has too often bred contempt, which has led the employee to cast aside the safeguards provided for him, and thus to lay himself liable to injury in the prosecution of his labor. Often, too, conditions over which he has no control and of which he is not aware, have interposed themselves, so that even if all ordinary precautions were observed he would still be liable to injury of a more or less serious nature. The appliances here referred to are intended to reduce these dangers to a minimum, while at the same time facilitating the work of the employee. The automatic cut-out shown is positive in action, and so arranged that when the lamp is lowered for trimming it is automatically cut out of circuit, rendering it perfectly safe for the workman to handle the lamp while standing on the ground. The cut-out mechanism is operated by the act of lowering, and the lamp is inserted in circuit again by the act of raising into position, not more than 18 inches of movement from its normal position being possible without cutting it entirely out of circuit.

The trolley mast arm is adapted to streets that are traversed by electric cars, and will suspend the lamp directly over the trolley wire in cases where the street is too narrow to use the automatic arm. This is also provided with a cut-out box, so that in case of necessity the lamp may be handled without interrupting the main circuit. The cut-out boxes involve the principle of toggle joints or links actuated past a

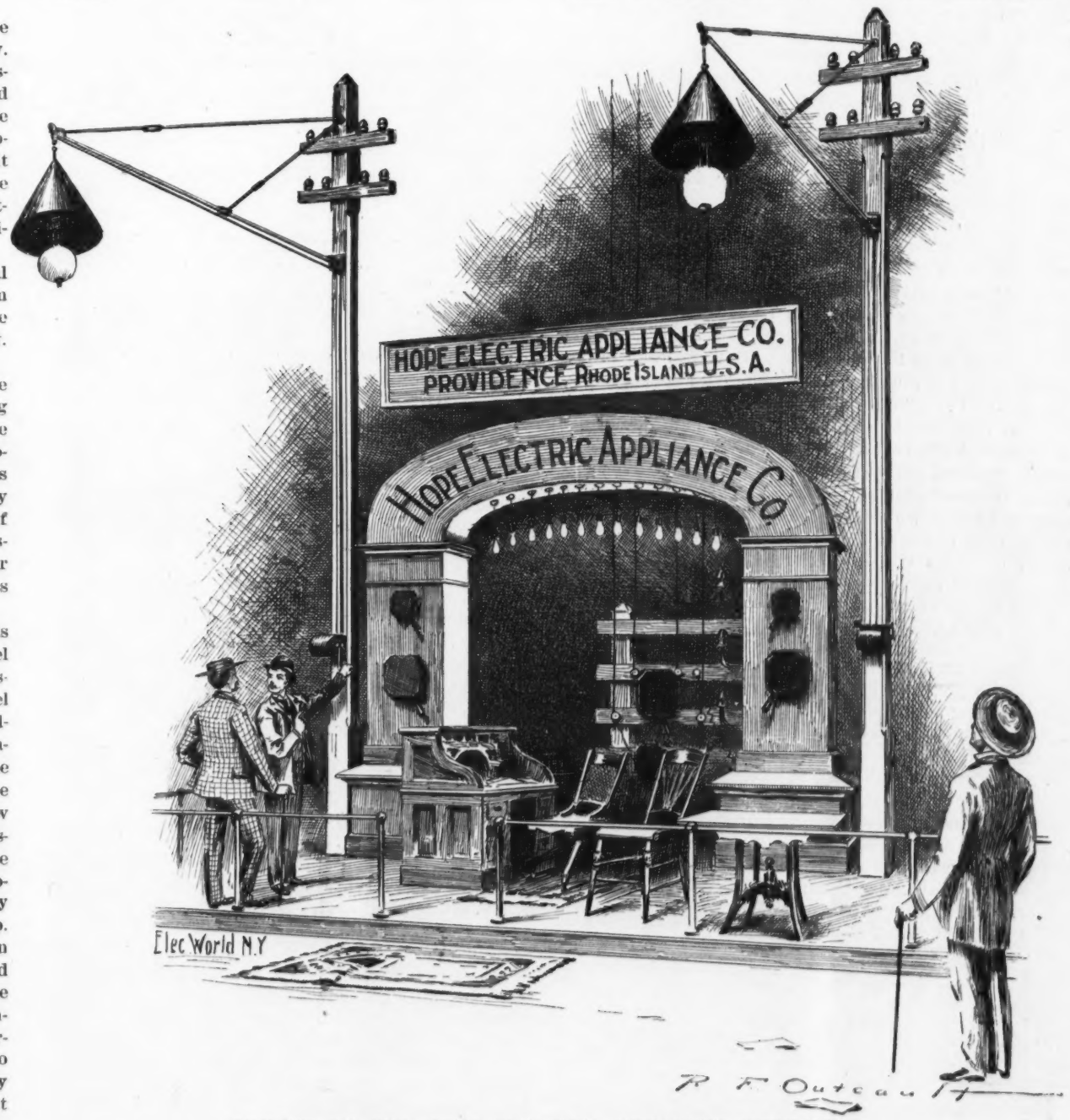
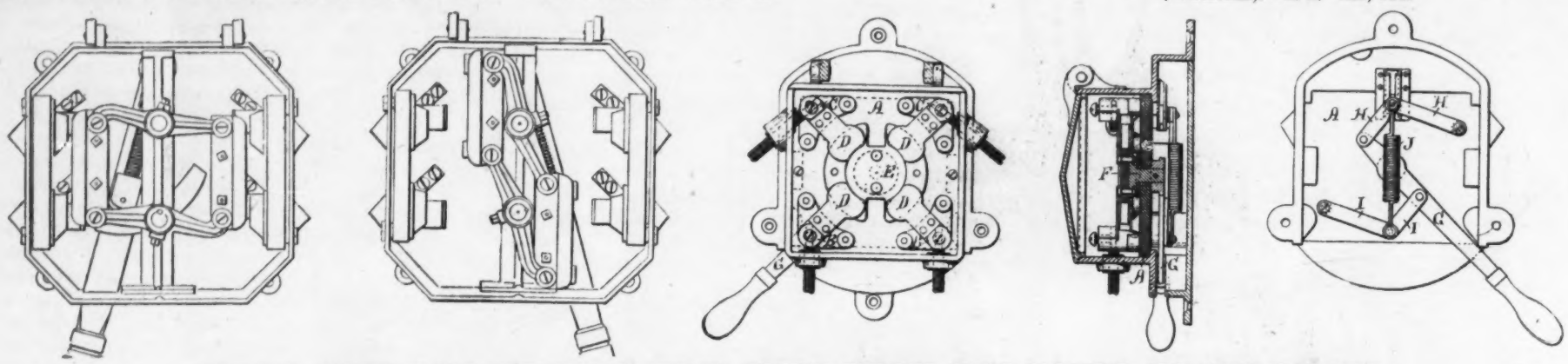


EXHIBIT OF THE HOPE ELECTRIC APPLIANCE COMPANY.

An interesting method of showing the operation of the thermostat is employed here; small lengths of shafting resting in journals equipped with this instrument are electrically heated, and when the predetermined temperature is reached the alarm is sounded. Perhaps a more practical illustration could not be devised than this.

centre by means of a coiled string, thus embodying the quick-action principle. The arrangement is also such that by a slight movement of the lever in either direction the throw is rendered complete by the spring, thus

rendering it impossible for the switch to remain between points. The dimensions of these boxes are 7 x 5½ x 3¼ inches. For multiple arc circuits they show another quick action switch, known as the Wright bi-polar box. This is also quick-acting in principle, and is supplied with fuses. The size of this box is 8½ x 8½ x 3½. In both



WRIGHT'S MULTIPLE ARC CUT-OUT AND SERIES CIRCUIT CUT-OUT.—HOPE ELECTRIC APPLIANCE COMPANY.

of these switches the mechanism is new, and its certainty and quickness of action recommend it to the electrical public.

Lighting of the World's Fair Grounds Compared with Sunlight.

Prof. Blake, of the University of Kansas, in one of his University Extension lectures delivered at Kansas City, Mo., gives an interesting comparison between the light of the sun and the artificial light from electricity at the World's Fair. By Prof. Langley's experiments on Mount Whitney, the Professor states, 1.6 kilowatts of energy per square metre of earth's surface is received from the sun when vertical. As the energy received would vary as the cosine of the sun's altitude, this would average almost one kilowatt per square metre for different positions of the sun. Of this power only 35 per cent. is light. The area of the World's Fair grounds is 1,037 acres, or 4,200,000 square metres. To light this space by the sun will require 1,466,500,000 watts, or 1,965,000 h. p. In lighting the grounds by electricity 5,200 arc and 90,000 incandescent lamps will be used, according to statements in The Electrical World, which will require 14,200 h. p. So that the sun expends about 140 times more energy to light the World's Fair grounds than man.

The American Institute Headquarters at the World's Fair.

Messrs. Ralph W. Pope and W. J. Hammer arrived in Chicago on the 22d inst. for the purpose of establishing a headquarters for the members of the American Institute of Electrical Engineers at the World's Fair. The rooms assigned for this purpose are in the gallery at the south end of Electricity Building, and overlook the electrical fountains and the grand plaza. The location is an admirable one, and it is believed that the plan of having a headquarters where electrical men can meet and be sociable will be one of the pleasantest features of the Fair. Many plans have been decided upon to add to the attractiveness of the place as a rendezvous, among which will be the collection of historical sketches, models and relics, a very complete reference library and files of all the electrical papers, besides those of the leading dailies of the principal cities of this country. One of the most keenly felt wants will also be supplied, viz., a place where friends can sit down and enjoy a smoke. Here, over their cigars, it is expected that many important as well as trivial questions will be discussed, new acquaintances made and old ones renewed,

The Accumulator in Commercial Work.

In The Electrical World of Dec. 5 a check list of accumulators prepared by Mr. J. Stanford Brown was published, giving references to the various American and foreign electrical journals by which a description of any particular style of accumulator could readily be found. In order to increase the value of this reference list Mr. Brown has carefully revised it, making a large number of additions, and the corrected list is here given in full. The abbreviations used are as follows:

American periodicals are given in small capitals and the English in capital letters, thus:

E. W. The Electrical World, New York.
E. E. *The Electrical Engineer*, "
E. R. " *Review*, "
E. A. " *Age*, "
E. P. *Electric Power*, "
W. E. *Western Electrician*, Chicago.
E. E. *Electrical Engineer*, London.
E. R. " *Review*, "
L. E. *The Electrician*, "

The abbreviations used for other periodicals explain themselves to those familiar with electrical literature.

ACCUMULATOR CHECK LIST.

Alkaline.—L. E. xxii., 213; see also Commelin, Elwell & Cie.
Aluminium.—E. R. xxix., 732.
"Atlas," see Hering.
"Anglo-American," see Sorley.
Bailly ("Phœnix"), E. W. x., 7.
Bandsept.—E. E. xii., 427; L. E. xxi.; xxii., 38; xxviii., 123; E. W. xix., 29.
Barbier (vs. Woodward).—E. R. xxxiv., 106.
Barbour-Starkey.—L. E. xxv., 719; xxviii., 145; E. R. xxvi., 437; E. W. xix, 45.
Barker (ZnPb, peroxide; anticipated by Woodward).—E.W. xiv., 197; E. R. xxix., 540.
"B. T. K.," see Beeman, etc.
Beeman, Taylor & King.—L. E. xii., 395; xiii., 118; xiv., 51, 499; E. W. vi., 7.
Blanc & Co.—E. E iv., 99.
Bradbury & Stone.—E. E. vii., 433; E. W. xviii., 98.
Brush.—E. E. iii., 476; L. E. xii., 294; xxvi., 474; E. W. xix., 54.
"Cambridge," see Hatch.
Carpenter.—E. W. xiv., 276.
Cély (Sarcia).—E. W. xviii., 385.
Commelin, Desmazures & Bailhache (CuZn, alkaline).—E. W. xiv., 177; xvii., 19; E. E. iii., 416; E. E. xii., 548, L. E. xx., 13; xxii., 302; xxvi., 195.
Consolidated Electric Storage Co.—See Julien.
Correns.—E. E. viii., 569; xii., 497; E. W. xviii., 251; xix. 45; L. E. xxvii., 592; xxviii., 144; E. R. xxv., 99; xxix., 268.
Crompton-Howell.—E. W. xix., 29, 59; E. E. viii., 567, 568; ix., 38; L. E. xxviii., 122.
Currie (lead chloride).—E. R. xxvii., 477; E. E. x., 375; xi., 72, 268; E. W. xix., 29; L. E. xxviii., 123.
D'Arsonval.—L. E. xxviii., 122; E. W., xix., 29.
Desmazures.—E. W. xix., 29; See also Commelin.
Dey (experimental).—E. E. xi., 162; L. E. xxvi., 506.
Donaldson-McRae.—E. E. xii., 641.
"D. P."—See Drake and Gorham.
Drake & Gorham.—E. E. viii., 567, 568, 589; L. E. xxviii., 122; E. W. xix., 29, 45, 59.
Dujardin.—E. E. viii., 428.
Eickemeyer.—E. W. xiv., 304; L. E. xxiv., 135.
Electrical Acc. Co., N. Y.—E. W. xiv., 102; xviii., 385.
Elwell & Cie (CuZn, alkaline).—E. W. xviii., 385.
Elwell-Parker (+ Planté — Faure).—L. E. xi., 130; xii., 214, 255; xiv., 187; xv., 42; xvi., 212; xxii., 735; xxviii., 122; E. W. xix, 29.
'E. P. S."—See Electrical Power Storage Company.
Electrical Power Storage Co. ("E. P. S.")—E. E. vi., 313; viii., 428, 568; L. E. xiii., 320; xix., 209; xxi., 90; xxii., 735; xxvi., 5; E. W. xviii., 385; xxviii., 123; type 1888, E. W. xix., 59; type 1890, E. W. xix., 45, 59; type K, 1891, E. E. viii., 579.
Entz.—See Waddell.
Epstein.—E. E. vii., 480; E.W. xix., 29; L. E., xxviii., 122. 230.
Ernst.—E. E. xi., 158.
Farbaky & Schenck.—E. W. viii., 62; L. E. xvii., 190.
Faure (1880).—E. W. vi., 7; E. E. viii., 409; L. E. xxi., 218; xxii., 38; xxviii., 122; E. W. xix., 29; type 1888, L. E. xxii., 117.
Faure-Sellon-Volckmar.—L. E. xii., 306; xiii., 59, 435; E. R. xxv., 469; E. W. xviii., 388.
F. S. V.-Gadot.—L. E. xiii., 290.
Fitzgerald (Lithanode).—E. W. vii., 198; xix., 29, 45; L. E. xxvii., 691; xxviii, 122, 123; E. R. xxix., 310.
Frankland.—L. E. xxii., 204, 205, 230.
Fuller.—E. W. xix., 45; L. E. xxviii., 145.
Gadot.—L. E., xiv., 142; xxi., 605; E. W. xviii., 385; E. E. viii., 568; E. W. xix., 45, 59.
Garassino.—E. W. xviii., 385.
Gaudini.—E. R. xxix., 323.
Gibson.—E. R. xxiv., 23; xxviii., 438; L. E. xxi., 103.
Glaesener.—L. E. xv., 200.
Hagen.—E. W. xviii., 251, 385; E. E. vi., 566.
"Hair."—L. E. xviii., 153.
Hatch ("Cambridge").—E. E. xi., 184; E. W. xvii., 2, 46.
Hedges.—L. E. xix., 485.
Hering ("Atlas").—L. E. xxviii., 145; E. E. vi., 9; viii., 568; ix., 447; E. W. xv., 403; xix., 45, 59.
Hering, Abdank-Abakanowicz, d'Arsonval & Picou.—E. E. xi., 299; L. E. xxvi., 484; E. R. xxviii., 207.
Heyl.—E. E. viii., 483; E. E. xii., 710.
Hollingshead.—E. E. x., 256.
Howell.—L. E. xx., 695, 727, 751.
Huber.—E. W. xviii., 385.
James.—L. E. xxvi., 751.
Jarman.—E. E. x., 470; E. R. xxviii., 224; xxix., 46.
Johnson E. R. xxvii., 446.
Julien.—E. W. ix., 240; xviii., 252, 385; L. E. xx., 192; xxii., 165, 205; xxviii., 203; E. E viii., 568,
Julien (C. E. S. Co.)—E. W. xix., 59.
Kabath.—L. E. ix., 61; xi., 436.
Kalisher.—L. E. xv., 41.
De Khotinsky.—E. E. xii., 534; E. W. xviii., 252, 385.
Kirchhoff (1861).—L. E. xvii., 111; E. W. vii., 257, 260.
" (American).—E. E. viii, 567.
Knowles-Julien.—E. W. xiii., 160; xiv., 34.
" " (anticipated by Sellon).—L. E. xxiii., 388.
Lalande & Cheperon.—(CuZn, alkaline).—E. W. xviii., 385.
Lalande-Cheperon-Desmazures.—L. E. xxviii., 122.
Laurent-Cely.—E. E. viii., 482; ix., 477; E. R. xxvii., 277; L. E. xxi., 320; xxv., 83, 108; xxviii., 123; E. W. xi., 429.
Legay.—L. E. xxviii., 123; E. E. viii., 568; E. W. xix., 29, 59.
"Lithanode."—See Fitzgerald.
Lloyd & Paxton.—St. Ry. Jrl. vii., 349.
Logan.—E. W. xiv., 426.
Lugo.—E. E. xii., 261; E E. iii., 106.
Macraeon (Planté—Faure).—Sci. xiii., 195.
Main (ZnPl, "River and Rail")—E. E. x., 132; xii., 548; E. W. xvi., 54.
Marx (Fe).—E. E. ix., 363, 435; E. E. viii., 124.
McLaughlin.—E. W. xvi., 249, 289.
Meserole (Zn).—E. E. xii., 548; E. W. x., 16.
"New Era."—E. W. xviii., 195.
Niblett (solid).—E. E. viii., 80; L. E. xxviii., 123; E. W. xix., 29.
"Oerlikon."—See Schoop.
Parod.—L. E. xiv., 175; E. W. v., 49.
Payer ($PbCl_2$).—E. W. xiv., 368.
Phillips.—See Waddell.
"Phœnix."—See Bailly.
Planté (1860).—E. W. v., 49; vi., 7; vii., 257; xiii., 192; xviii., 385; xix, 29; L. E. xii., 255; E. R. viii., 567; xxvii., 716.
Pollack.—E. E. viii., 428; ix., 309; xii., 534; E. W. xviii., 252, 385; E. R. xxvi., 377.
Pumpelly.—E. W. xiv., 426; xix., 45; L. E. xxviii., 145.
Reckenzaun.—L. E. xxii., 168, 230; type 1891, E. E. viii., 580.
Reynier (Zn).—E.W. xii., 548; L. E. xiv., 303; xxv., 186; xxvi., 113; xxviii., 145; E. E. viii., 567, 568; x., 666; E. W. viii., 102; x., 102; xvi., 440; xvii., 206; xix., 29, 45, 59.
Roberts.—L. E. xxviii., 144; E. E. viii., 567, 568; E W. xix., 45, 59.
Schoop ("Oerlikon," gelatine).—E. E. viii., 428, 567, 568, 569; xii., 534; E. W. xiv., 33; xviii., 252, 385; L. E. xxiii., 187; xxv., 245, 253; xxviii., 122, 146; E. W. xix., 29, 45, 59.
Sellon.—See Faure-Sellon Volckmar.
Siemens.—E. W., xix., 29.
Slattery.—El. Ry. Advr., ii., 45.
Smith-Cornelius.—L. E. xix., 216.
S. A. p. l. T. E. d. M. ("St. Ouen").—E. E. viii., 428, 485; Ey. i., 279; E. R. xxix., 593.
Slattery (Alkaline Zincate).—L. E. xxviii., 179.
Sorley ("Anglo-American").—E. W. xiv., 50, 140.
Starkey.—See Barbour-Starkey.
Starr (Planté).—L. E. xiv., 29.
Sutton.—E. W. xix., 29.
Swan.—E. W. xix., 45.
Tatham.—E. E. iii., 132; E. W. xiii., 158.
Tamine.—E. W. x., 76.
Tommasi (Multitubular).—E. R. xxix., 497; E. E. viii., 567, 568; x., 671; xii., 555; Elec. Ent. ii., 382; L. E. xxvii., 681; xxviii., 144; E. W. xix., 45, 59.
Tommasi (anticipates Woodward).—L. E. xxvi., 130, 182; E. E. viii., 569.
Thomson-Houston ("T. H.").—L. E. xxviii., 122; E. W. xix., 29.
Tribe.—E. W. xix., 29.
Tudor (Planté).—E. E. viii., 567, 568; ix., 35; xii., 497; E. W. xviii., 251, 385; L. E. xxi., 165, 180, 490; xxvii., 592; xxviii., 38, 123, 145; E. R. xxix., 268; E. W. xix., 45, 59.
Van Gastel.—E. W. ix., 191; L. E. xxiii., 536.
Waddell-Entz-Phillips (Cu oxide, alkaline).—E. E. x., 537; E. W. xv., 190; xvii., 354; xviii., 385; L. E. xxvii., 647; xxviii., 49, 97, 122; E. R. xxviii., 675; E. W. xix., 92.
Washburn.—E. E. xi., 546.
Winkler.—E. E. xii., 108.
Woodward.—E. W. xiii., 177; E. E. vii., 82; L. E. xxii., 157.
Woodward (anticipated by Tommasi).—L. E. xxvi., 130, 182; E. E. xiii., 569.

A New Engineering Laboratory at the University of Pennsylvania.

BY EDWARD T. CHILD.

The formal opening of the new Laboratory of Mechanical and Electrical Engineering at the University of Pennsylvania completes what is in many respects the finest plant in the country for instruction in engineering. There are two buildings, comprising in all about 23,000 square feet of floor.

In the one-story boiler house are seven boilers of the largest size. The manufacturers have taken special pains to make each a model of its kind, and the design has been to represent all varieties—Galloway, return tubular, water tube and sectional. These boilers will furnish heat, light and power for all of the University buildings, some of them quite distant, and fine opportunities will be presented for the study of heat and power transmission.

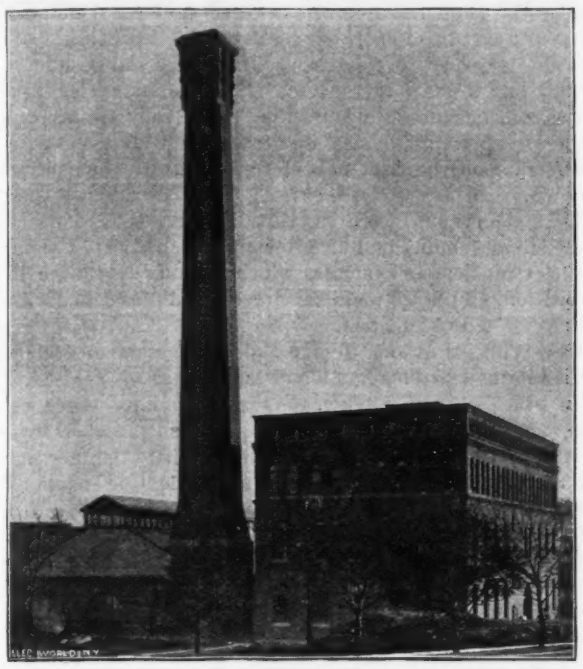


FIG. 1.—LABORATORY BUILDING.

All have been arranged to be tested by the students, and every appointment, while plain and simple, is of the most substantial and convenient kind. A chimney 152 feet high furnishes the draught. There is also a large fan arranged so that any or all of the boilers may be tested under forced draught. One section of this building is given up to the calorimeters, of which there are examples of all the well-known types. The building is fireproof, and lighted by both gas and electricity.

Immediately adjoining the boiler house is the laboratory building, three and one-half stories high and of mill construction. It is heated by steam and lighted by electricity, although gas is introduced for Bunsen burners and the like.

On the first floor are the engine room and a mechanical laboratory. The former contains at present a 100-h. p. Westinghouse compound engine driving Brush and United States dynamos, and a 100-h. p. Porter-Allen engine, driving Edson and Thomson-Houston dynamos. A 100-h. p. Armington & Sims engine, a 100-h. p. straight line engine, and a 50-h. p. Buckeye engine, together with five more direct and alternating current dynamos of various types, are to be put in place in the near future. The switchboard in this room is very fully equipped with instruments, and the current from any or all of the dynamos can be sent to any part of the building for test purposes, or to any building or group of buildings that may be desired.

FIG. 3.—DYNAMO ROOM.

In the mechanical laboratory are a 45-h. p. Porter-Allen engine and a 30-h. p. Corliss engine. These can be run either simple or compound, condensing or non-condensing. There are also several steam pumps and a large cistern and weir. Several varieties of turbines belong to the department, and are to be placed in position here. The Porter-Allen engine supplies power for the adjoining wood and iron shops, but the Corliss engine is used for nothing but testing. The engine plant is completed by six other small engines which drive rotary fans.

On the second floor are the library and reading rooms, offices and toilet rooms, class rooms and a large mechanical and electric laboratory. Here are testing machines for wood, iron and steel, oils, cements, steam gauges and indicators. There is also gas-testing apparatus. Edison and Weston direct current dynamos, a Westinghouse alternator and an Eddy motor in this room are used exclusively for testing purposes. Here, too, are to be placed air and gas motors, which of late have offered peculiar attractions to the engineer.

The third floor is given up to a drawing room, a class room and office and an electrical laboratory. No iron, not even a tack, has been allowed in the construction of the building anywhere within eight feet of this laboratory. A switchboard here is connected with each separate table in the room, with the laboratory on the second floor and with the main switchboard downstairs, so that convenient connections, capable of carrying heavy currents, may be made throughout the whole building. There is a large equipment of instruments, which is continually being augmented. A well arranged dark room offers facilities for photometric work.

The fourth floor containes a blue print room and a model room. The building has been in use for a number of months, and is now in thorough working order.

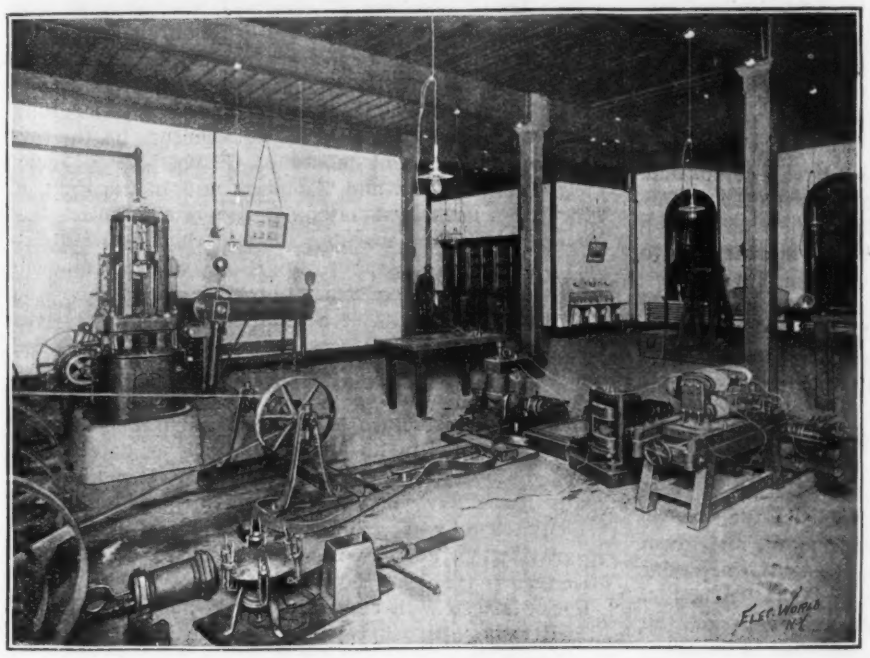


FIG. 2.—MECHANICAL LABORATORY.

Pattern making and work in the iron shop form essential parts in the course of study, but it is the object of the department to turn out engineers, not machinists nor electricians. The enormous plant of the University forms what is practically a small town. In his later years the student is given charge of the problems that turn up, and is thrown largely on his own resources. The whole plant is his. He is, of course, carefully watched by the instructor, but it takes but a short course in such work to render him quick in seeing and correcting faults and in inventing ways of overcoming difficulties. Apparatus may be damaged now and then, and the work is not done so quickly as it would be if the student had it all laid out for him in advance, but surely the practical experience gained by this mode of teaching is invaluable.

Situated in a great manufacturing city, examples of engineering successes and failures are to be found on every hand. Every Friday afternoon during the winter is spent by the students in visiting industrial establishments. Papers are then submitted criticising the general arrangement of the plants, the quality and quantity of the work, the means for producing and distributing power, the lighting, heating and ventilating, the facilities for transportation and the details of the electric outfit from the dynamo and switchboard to the lamp.

The city central stations offer special courtesies and facilities for a thorough investigation and study.

Besides all the courses of lectures and recitations usual in engineering colleges, individual investigations are made and reports read. Successful specialists give short talks and specifications, contracts and business law are taught by a leading member of the Philadelphia bar.

The Economy of Small Lighting Stations.—II.

BY JAMES B. CAHOON.

The "rejuvenated" plant of which we spoke was almost identically like the first plant in many particulars as regards building, boilers, apparatus and line. After running for four years they finally had to shut down, and the plant was purchased at about one-fifth its original cost by a syndicate of men whose names are fairly well known in the electrical field. The station had, however, a distinct advantage in its situation, being in the centre of the town and so situated as regards railway track that by a small expenditure of money a siding could be put in which would land their coal at their own coalshed. There was a difference, too, in the engines, for while both stations required the same amount of power, the second station had an engine of 300 h. p. and one of 150 h. p., so that when their load was light they were enabled to shut down the large engine and only run the small one. The services of a competent electrical engineer were secured, and he was told to remodel the station, re-equip it in the best possible manner, so as get a maximum output with a minimum expenditure of power. At the end of three months we find the station again running, with the following changes: The whole inside of the building has been remodeled, with cement and stone foundations prepared for engines and dynamos; the boilers have been removed and a separate building adjoining the end of the station has been erected for their use, and just beyond this the coalshed has been put up, along the front of which runs a car track, and chutes to deliver coal have been provided. It was found that by going something like 100 yards an ample water supply can be obtained for the use of a condenser. The old boilers were sold, and one of the latest improved models of water tube high pressure boilers was substituted. A jet condenser was added so that the engines could run as condensing engines. A feed-water heater was also supplied, and we find the engines so situated now that but a short length of steam pipe is needed to connect them with the boilers. The old electric apparatus has given way in part to new, what could be used being retained. Outside, the old pole line was entirely taken down, and new poles with chamfered edges were set in their places and well painted; new lines were run in place of the old, which were taken down and sold for old copper. This last was to a large degree an unnecessary expense, as the old poles would have done well enough, and a good portion of the lines, with a proper man to look after them, could have been utilized, but the syndicate felt at the start they must put things in the best shape possible or people would not patronize them, and for that reason alone new lines were constructed. By the change in the station and the moving of the boilers there was ample provision left for double the service for which they already had apparatus. In putting in the foundations, a foundation was built for an extra engine of 300 h. p., and the same provision was made all through the station for increased service.

FIG. 4.—ELECTRICAL LABORATORY

This occurred nearly two years ago, and we find at the end of the first six months it became necessary to purchase a new engine and boiler to meet the increased demand. An experienced electrician, with a good chief en-

gineer and assistant and the best firemen that could be obtained, are looking after things in such first-class shape that we find that with a good quality of Cumberland coal, and steam at 120 pounds, the boilers show an evaporation of 9.8 pounds water per pound of combustible, and the engines an economy of 2.1 pounds of coal per h. p. per hour, this last not being the maximum that has been done, but happened to be the average for two or three days at the time it was called for. This plant is now running 250 arc lamps and 3,000 incandescent alternating, and furnishing about 60 h. p. in motors.

The plant is run with the following force: Secretary and treasurer, who is business manager; a superintendent, two linemen and two helpers, two dynamo tenders, a chief engineer and assistant, two firemen, three trimmers and one inspector. As the prices paid these men are a fair sample of what it is necessary to pay good men, it will do no harm to quote them:

Superintendent	$1,500 per year.
Chief engineer	1,200 " "
Assistant engineer	750 " "
Linemen, firemen, one dynamo tender	2.50 per day, each
One dynamo tender	2.00 " " "
Linemen's helpers	1.50 " " "
Lamp trimmers	1.75 " " "
Inspector	2.00 " " "

These men are all proud of their station, take an interest in their work, believe they are well treated, and do what they can to help along the interests of the company. Everything is neat and clean around the station and in connection with their lights. They have even gone so far as to paint their dynamos white and put a little extra gilding in places. Wherever there is a chance for any oil to drip or fly on the floor galvanized iron trays have been placed to catch the waste. This plant is netting its owners a very handsome return for their investment, and, in point of fact, the plant will pay for itself in a very few years.

Our other plant will probably be purchased by a syndicate and transformed in a similar manner in about another year and a half.

There is plenty of money to be made in the electric light business if conducted in a proper way, and much has been written and spoken in regard to the necessity for economy in the operation of central station plants, but it seems an extremely difficult matter to get the owners of those plants to understand what is economy as regards their plant, and what is not. The great majority seem to forget that an electrical business has got to be run on the same business principles as any other business, and that if you want good work done it must be paid for, and that it is more economical to pay for good work once done than to pay for poor work half a dozen times over; or, in other words, I would say to owners of electric properties, if you are not receiving a dividend from your investment, to use a homely phrase, "There is a nigger in the woodpile" and you want to find the "nigger," to do which go to some first-class electrical engineer and get him to look over your plant and tell you where the trouble is; then tell him to see that that trouble is remedied, and so follow on step by step on the plan of the syndicate mentioned above, and you will find your electrical property will pay you well.

From the Centennial Exposition to the World's Fair.

BY THOMAS D. LOCKWOOD.

While the professional electrician and electrical engineer of all living men must keep his eyes always fixed on the "to be," and must have his mind firmly planted on the "is," he must yet, if he would fill the measure of his usefulness, be likewise fully informed concerning the "has been" and "was" of things concerning his profession, and be at all times ready to take stock, so that the extent of his advance may be accurately estimated, and so that he may be made humble or encouraged, as circumstances may require.

In view of the facts that the Centennial year and its exposition marked the inception, as the present year 1893 and its Columbian Exposition and auxiliary enterprises mark the culmination of seventeen years of unprecedented progress in the knowledge of electrical science, and in the industrial applications of electricity, a retrospective view from 1893 to 1876 is in order, and will certainly be interesting and probably instructive.

The interest attaching to this period of time is enhanced by our recollection that it is provided with a halfway house in the year 1884—the year in which occurred the first American exposition devoted entirely to electricity, and an associated national electrical conference, and which, moreover, was signalized by the organization of that now flourishing society, the American Institute of Electrical Engineers.

The progress of the period under consideration is not confined to the several arts most closely allied to electrical science, but includes the domain of electrical journalism, the electrical societies and electrical invention as disclosed in the work of the United States Patent Office, and a statement of the work done between 1876 and 1893 would clearly be incomplete were it to omit a reference to these important lines of advance.

The first third of the nineteenth century rounded out the regime of principle elucidation, dimly foreshadowed in the year 1600 by Gilbert, and comprising the successive epoch-making discoveries of conduction and insulation by Gray in 1729; the Leyden jar chapter in the storage of electrical energy by Kleist in 1745; the demonstration of the identity of earth produced electricity with the fiery falchion of Jove in 1752 by Franklin; the galvanic and voltaic researches during the period ranging from 1780 to 1800, culminating in the voltaic pile, and followed by Davy's discoveries leading to the establishment of the sub-science of electro-chemistry; the discovery by Oersted of electro-magnetism, and the working out of its theory by Ampere in 1819; the speedy embodiment of the compound science in the modern electromagnet (the foundation feature of all electromagnetic apparatus) by means of the successive labors and consecutive advances of Arago (1820), Sturgeon (1824) and Henry (1828); and finally the masterly work of Faraday, closely and remarkably paralleled by his American prototype, Henry, in that grand series of experimental researches in magneto-electric mutual and self induction, which were fully completed by 1835.

This broad platform of electrical discovery, at first singly, and later still more broadened and strengthened by association with the modern truths of the conservation of energy, which founded, and seen " as through a glass darkly" by Carnot as early as 1824, was fully established before the middle of the century by the several and independent labors of Grove, Mayer, Joule, Faraday, Helmholtz and Thomson, and in the light of which the mediaeval myth of perpetual motion has disappeared as the morning mist of the morass disappears before the rays of the rising sun; so that no longer aspiring to construct automata which have the multitudinous powers of a man, we content ourselves with making machines possessing one of such powers, but possessing it a thousandfold or more, constitutes the solid foundation on which has been reared a stupendous superstructure of invention, which, beginning brick after brick in its lower courses even before Oersted's discovery, has continued to grow year by year, as its bases have broadened, with an ever-increasing velocity, thereby asserting its independence of the laws of gravitation, and its freedom from the serfdom of gravity.

For it is true with respect to invention, as Helmholtz held it to be with respect to the correlation of Nature's manifestations:

> Where a step stirs a thousand threads,
> The shuttles shoot from side to side,
> The fibres flow unseen,
> And one shock strikes a thousand combinations;

and as our own experience testifies, each great invention speedily proves the nucleus of a large and varied assortment of either subsidiary or rival inventions of the same order; the former intended to aid the usefulness of, or to satisfy new wants created by, the parent invention, and the latter aspiring to a division of the profits accruing or supposed to accrue from the original invention.

It is also to be remembered that invention reacts on discovery, and that both react upon pure science by furnishing improved instruments for research, which lead in turn to an additional cycle of discovery and invention.

One of the ablest, most brilliant and most productive delvers into the secrets of electrical phenomena enunciated in 1874 his own conviction that "electrical science has yet much to hope for from the observations and experience of practical men, and practical electricity may still hope for the beneficial elucidation of principles from science." The philosopher was entitled to this view both by his own experience and by the universal history of all science, which unmistakably points to the conclusion that science and practical application regularly act and react upon one another, and to accomplish great deeds must ever walk hand in hand.

In this way, to slightly anticipate, the dynamo made electric lighting commercially possible, and this in turn reacted on the dynamo, improving its form, arrangement and developing its theory. Incandescent lighting, calling for cheaper mains, introduced the transformer, and this again brought out a high grade of alternating machine, all joining in calling for improved regulators, carbons, measuring appliances, meters and circuit arrangements.

So in telephony, we find first a host of improved forms or forms alleging themselves to be improvements, then call bells, call generators, systems, switchboards, simple switches, induction neutralizing devices, and protective appliances; and as early as 1885 Patent Commissioner Butterworth used, in his annual report to Congress, this field of invention as an illustration of the mode in which subsidiary patents necessarily cluster round a parent invention.

We may easily believe that the discoveries of the past were at the time they were made in some degree undervalued, since it is within our own experience that in the fierce light of competition some of the greatest achievements in making such discoveries practically available have not to the fullest extent been contemporaneously appreciated. Inasmuch, however, as contemplated now through the mellowing telescope of history, from a point of view suitably distant, and in the light afforded by results, we are better fitted to properly estimate the great deeds of our predecessors; so may we hope that the perspective of the future will, the mists being cleared away, do full justice to the men who have built the grand and useful inventions of the present on the stable discoveries of the past.

In 1876, then, we already were familiar with forms and methods of telegraphy too numerous to mention.

Under our own observation was still the old reliable Morse relay, key and sounder system, which oft opposed still reared its proud front undismayed, for the simple reason that to do good work it asks only for good men.

The duplex and quadruplex methods of multiplying the carrying power of circuits, by providing the wire with one or more phantom lines were both in practical and serviceable operation, the former having already become an old story, and the supercession of the old combination printer by the most improved and magnificent modern Phelps printing instrument was under consideration.

The type printing stock and gold quotation printers, under the popular name of "tickers," had for a number of years past been operated by the Gold and Stock Telegraph Company in New York and other cities, and it is but fair to state the service of this company in those days of darkness, when the electrical engineering courses of technological institutes had not yet been evolved, was the best school for practical electricians known.

Dial telegraphs were universally favored by police boards, and municipal fire telegraphs, as well as the district messenger systems, which already had been in operation, employed metallic circuits and different forms of circuit wheel call box.

The Watkins automatic fire and burglar alarm system was also in existence, and had been since about 1874.

In other countries telegraphy was running much on the same lines; in England, especially, so far as instruments and systems were concerned, a little behind, but in the matters of construction and scientific management considerably ahead of us; in England, also, the Wheatstone automatic system had been in use for a long time, and was justly and highly prized as a most valuable means for the speedy transmission of intelligence, and especially intelligence such as newspaper matter, which required sending to many different places.

The field of harmonic multiple telegraphy was also under cultivation, and the seed sown in 1870 by Varley, which apparently had been cast on profitless waters, was now, after many days, to show that it had not been sown in vain; for, by 1876, Elisha Gray, Paul La Cour and Graham Bell had all done much and good work in this line of invention. It has been the misfortune of the different plans for harmonic multiple telegraphy that the times when they were ripe for practical application were likewise the times when other inventions in, and applications of, electricity constituting newer, more fascinating, and more radical innovations, and promising greater rewards, also appeared, and that it therefore has relatively been neglected, and has not been the recipient of such practical improvements as can only be suggested by the observations of practical and regular work.

I am, however, convinced that there is a future for harmonic telegraphy, and that ways and means will be formed for its widespread commercial adoption, and for the promotion of its practical usefulness.

(*To be continued.*)

Underground Conduit Railway in Budapest.

The following information is embodied in a recent report of Edward P. T. Hammond, U. S. Consul at Budapest, and possesses considerable interest:

The Siemens-Halske electric street railway system was introduced into Budapest three years ago, and is now in operation on nearly seven miles of double-tracked road. Sixty cars, each with a seating capacity for 32 persons, are run over the line at an average speed of 12 miles an hour. The electric current is transmitted from a central power station through an underground conduit, from which connection is made to the motor of the cars.

The service has been exceedingly satisfactory to the public, the only short interruptions having been caused on a few occasions by unusually heavy falls of snow. The rate of speed could easily be doubled, but municipal regulations forbid any increase.

The fare charged varies from 2½ to 4 cents, according to the distance. Transfer tickets are issued for 4 cents.

The company operating the road has obtained concessions for an extension of about three miles over some of the principal streets, and further concessions will probably be secured.

The following facts in relation to the construction and equipment of the railway were furnished by parties in this city (the company publishing no reports): Cost of roadbed (rails, excavating, masonry, paving and switches), about $2,880 per mile of single track; cost of cars, including motors, $6,000 each; weight of cars, including motor, 5 tons; cost of buildings, $15,000; five boilers, with grates and masonry, $20,000; machinery (engines, dynamos, switchboard, etc.), $70,000; cost of running one car per mile (maintenance of track, labor at power station, fuel, employes on cars, etc.), 5½ cents.

THE ELECTRICAL WORLD'S DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE.

(Compiled from the principal foreign electrical journals.)

BY CARL HERING.

ELECTRO-PHYSICS.

Electric Interferences.—"L'Elec.," May 20, contains a note by Mr. Colzon in which he shows an interference phenomenon; a Ruhmkorff coil is discharged through the film of a poorly conducting liquid and the location of the interference points determined by a telephone, one pole of which is in contact with the liquid film and the other insulated or connected to a constant capacity; on moving the one pole over the surface of the liquid a series of neutral points will be found; for tracing these curves the liquid film is made of a piece of blotting paper moistened with the liquid, and wherever a neutral point is found a hole is pierced in the paper.

Oscillations of a Wire Traversed by a Current.—"Electricite," June 8, contains an article by Mr. Hurmuzescu, in which he describes the following experiment: If a continuous current be passed through a horizontal wire stretched to the proper tension it will vibrate in a vertical plane, the vibrations becoming more and more rapid as the tension is increased; a slight impulse given to the wire starts the vibrations, which continue to increase up to a certain maximum; under certain circumstances the single wave may be broken up into a number of smaller waves; sufficient current should be used to bring the wire to redness, although somewhat less will also answer; the experiment succeeded equally well with various metals; a german silver wire, .16 millimetre diameter and 2 metres long, with a current of 2 amperes, vibrated so as to form one wave whose amplitude was 30 to 40 millimetres; other conditions being the same, the maximum amplitudes of the vibration were as 1 to 3 to 7 in air, illuminating gas and hydrogen, respectively; in vacuum no oscillations could be produced. He believes the phenomenon is due to the periodic vibrations of the temperature and of the resistance due to intermittent cooling effects.

Electrodeless Vacuum Tubes.—Dr. Bottomley, before the Glasgow Phil. Soc., showed that many phenomena in vacuum tubes could be produced in tubes without electrodes; he showed that the phenomena were highly complicated with the mixed effects of the current induction and of electrostatic induction, and that the electrostatic disturbances of the vacuum had not been sufficiently taken into account in attempts to explain these phenomena.

Condensers in Alternate Current Work.—Mr. Sahulka continues his article (see Digest, June 10) in the "Elek. Zeitschrift," May 26. He discusses the introduction of a condenser into a circuit to produce a certain phase difference. The formulas were all of a simple nature. His article is concluded in the issue of June 2, in which he takes up several other cases, including a condenser in the secondary circuit of a transformer.

MAGNETISM.

Influence of Longitudinal Magnetization on an Iron Copper Thermo-couple.—M. Chassagny, before the French Academy of Sciences, describes some researches in which he found that in a couple, kept at 0° and 100° C., longitudinal magnetization of the iron increases the E. M. F., and that this increase is independent of the direction of magnetization; a short extract is contained in "L'Ind. Elec.," May 25.

Rotary Magnetic Fields.—In a mathematical article in the London "Electrical Review," June 2, Mr. Russell discusses graphically the application of a theory in elementary statics.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Congress Proposals.—(Discussion of the American Proposals in Germany, continued.) Regarding the nomenclature and symbols, proposed by Hospitalier, the German committee makes the following suggestions: That for angles not only the letter α, but also β and γ be used, as it is frequently necessary to represent several angles; to use the letters u, v and u for velocities, and for acceleration the letters u, v and w, instead of A; that for forces, besides the letter F, also the letter f be used; although moment and work have the same dimensions, it suggests giving them different letters, and as T, M, m are already taken up, it suggests using D for moments, as it is the initial letter of the German word "Drehung." Different letters are used by Hospitalier for field intensity, and for magnetizing force, which, however, are perfectly similar quantities, as a field is the same whether it is generated by magnetism from iron or from ampere turns, it therefore suggests using $\mathfrak{H}$ for both; it sees no reason for introducing the Greek letter Φ for flux of magnetic force, and suggests instead the letter $\mathfrak{S}$, which is the initial letter of the word "strom," or, in English, "stream." As it is often desirable to represent differences in potential by $U_2 - U_1$, and falls of potentials in the form $\frac{dU}{dl}$, it suggests that in such cases U be used to represent a potential. For current it suggests using not only J (it means I, the Germans use I and J almost indiscriminately), but also i as it is often necessary to represent several different currents; for the specific electrical resistance, Hospitalier uses α, and for the magnetic ρ, but it suggests that in accordance with universal use ρ should be reserved for electrical resistance and α be used for the magnetic; for electrical conductivity (conductance) and for specific conductivity Hospitalier has proposed no letters, and it therefore proposes the letter λ for specific conductivity because Kirchhoff was the first to use it, and for the conductance the letter G, as it is about the only letter of the Latin alphabet that would not cause confusion.

Regarding the C. G. S. units, Hospitalier's symbols could either be adopted or all composite units could simply be characterized as C. G. S. units; it suggests leaving this to the choice of those who use these terms. Regarding the mechanical units, it does not approve of using the same letter m for both meter and minute, and therefore proposes not to use the unit minute, but to write 60 seconds instead; it suggests using n for revolutions per second and 60 n for revolutions per minute-saying that the latter is preferable because in most cases revolutions must be reduced to seconds for further calculations; also that it is very desirable to represent both the "force of a kilogram" and the "mass of a kilogram" by a special sign, and suggests that in the former an asterisk be added to the letters g, kg. (This will hardly be acceptable to English-speaking people, as the asterisk is almost universally used for foot-note references, which in German literature is done by numerals.)

It approves most emphatically of the introduction of the metric system and the designation of the diameters of wires in that system, saying that the latter has been customary in Germany since 1880; it considers the introduction of the metric system to be one of the most important works of the Congress, and states that anything not conforming with the system should receive no consideration; it thinks that flooding the literature with new names does not tend to the introduction of the metric system, and it does not approve of the wholesale introduction of new names; it approves of the adoption of the kilowatt as the unit of power.

Mr. Boucherot's discussion of the American proposals is concluded in the May number of the "Bul. de la Soc. Int." He states that when the self-induction is variable there is no longer, strictly speaking, a coefficient of self-induction; however, it is of interest to retain the coefficient, and therefore to give it a general definition. In the particular case of a solenoid containing iron the three definitions of the coefficient of self-induction are applicable, although giving different results, and have equal right to priority; a system whether containing iron or not may be under the influence of exterior forces which involve variations in the self-induction; he illustrates this by an example. Regarding inductance, he states that if in a definition the inductance is compared to the inductive resistance, there will be a disagreement, as the inductive resistance of a condenser or a motor is positive, while its inductance is negative.

Legalizing Electrical Units.—Mr. Dobrowolsky, in the "Elek. Zeitschrift," May 26, discusses at some length the proposals of the Imperial Institute and the American proposals for the Congress; he discusses them from the standpoint of a practical engineer; the article is well worth the closest attention of those interested in this subject. Regarding the ohm, he says the practical electrician is not concerned with the proposed alteration, as that correction is too small to be of any consequence to them. He is most emphatic, however, in his discussion of the definitions of units and quantities, as that does concern the practical engineer; he objects to defining the ohm in terms of the weight of mercury instead of the cross-section, as he thinks that a resistance involves a conception of a cross-section. He protests at considerable length against the new definition of a current strength (in which it is defined by its electro-chemical equivalent per unit of time); electrical quantity is that which is measured directly by an electrolytic deposit, and to arrive at the current it is necessary to introduce the element of time; the only logical definition, therefore, would be to define the coulomb by its electro-chemical equivalent, as these two quantities are derivatives of each other under all circumstances and without qualification; the ampere is then to be defined, as heretofore, as a coulomb per second; the definition suggested by the Imperial Institute (the same as that suggested by the American Committee) he says is uselessly complicated, as it involves a division by time in order to determine the current, and then a multiplication by time in order to arrive at the quantity of electricity. He also criticises the definition of an alternating ampere; if an alternating current were commutated at the moment when its value is zero, and be used in a voltameter, for instance, depositing .00118 gramme of silver per second, why should it not also be called an ampere? and why should it, simply because it is an alternating current, be called 1.1 ampere? The mean quantity of electricity flowing is one coulomb per second, and it should therefore be called an ampere; an Aron meter, as also a tangent galvanometer, would measure it in this way; there are, of course, other instruments, like a calorimeter and electro-dynamometer, which would indicate the current as defined by the new definition; but there are still other methods of measuring which give different results from either of the above, namely, condensers and induction coils, in which there are a number of coulombs or lines of force, respectively, per half period, which are proportional to the maximum value of the current strength or the voltage. As the current strength will, therefore, be different according to what its purpose is, or how it is measured, it should either not be defined at all or there should be in all cases a common basis in order that a confusion in different cases does not arise; such a basis is simply the quantity of electricity, namely, the coulomb, as it is so simple and can be determined so accurately; the current is then the number of units of quantity flowing per second. With inconstant currents there are other values besides the mean which are of interest, namely, the maximum and the minimum, which, however, can just as well be expressed in amperes, for in defining the current strength by the quantity divided by the time, there is no condition that the time be one or more seconds; it can, for instance, be infinitesimally small; the most universal definition of current strength, therefore, would be the electrical quantity divided by the time, a definition which does not collide with any other. When concerned with the caloric value of the current, we know it to be proportional to the square of the current, in which lies the difficulty of calculating the caloric value of alternating currents; the heat effect of inconstant currents having the same mean strength is not always the same; as, for instance, one ampere for a given time or two amperes for half that time, in which the quantity of electricity was the same, and, therefore, also the mean current strength, but the heating effect is doubled; a periodic current following the sine law, be it direct or alternating, develops about 10% more heat than what would correspond to its mean value; if the variation is other than according to the sine law, this coefficient will be a different one; to determine the heating effect the C^2 R product must be taken for every instant, and the sum of this taken—one cannot simply take the mean current and square it; the mean of this square for a second is the factor which, when multiplied by the resistance, gives the heating effect per second, and is the substitute for the usual C^2; the square root of this mean is something analogous to the current, but not equal to it, and it would be better to call this the effective value of the current; as it has the same dimension as current, it can be measured in amperes, but it must not be forgotten that these amperes are to be interpreted and measured quite differently; it would be well, therefore, to add a prefix or sign, as, for instance, caloricampere, workampere, effectiveampere, and as the latter is already in use he suggests adopting it definitely; the term effectiveampere would therefore be merely an abbreviation of the expression for the square root of the mean of the squares of the momentary currents, as determined from the coulombs; he suggests not making a difference between direct and alternating currents, as has been done, because there are currents midway between these, and, therefore, in order to have a general expression for all, including the most irregular currents, he advocates reducing them all to the current as defined by a coulomb, which is itself defined by the electro-chemical equivalent. He gives these two definitions and adds that with variable currents the mean strength is the arithmetical mean of the momentary values of the current; and the effective strength is the square root of the mean of the squares of the momentary currents; when all the variations occur within a second, no further qualification is necessary, but in other cases the duration of a complete period must be given. For instance, one could speak of the effective current per day in amperes for electric railways, furnaces, accumulators or a telegraph station.

All that was said regarding current strength has reference equally well to the voltage; he defines the volt in terms of the ampere and the ohms, as also mean voltage and the effective voltage, for variable currents. Regarding electrical work and power he shows how the former is derived from the current strength, itself derived from the coulomb, and states that, as in mechanics, work should first be defined, after which power is defined in terms of work, as distinguished from defining work as power per unit of time, which latter would be equivalent to defining a length as a velocity multiplied by time; a watt should, therefore, be defined as a joule per second. He speaks of the measurement of electrical power, showing that when it is constant it may be calculated from the amperes and volts, if variable, as in railway circuits, by an integrating meter, and if varying rapidly, as in alternating currents, by a wattmeter, or finally by a calorimeter; if the law of variation is known, as is sometimes the case in alternating currents, it can be calculated from the maximum value; the same if the angle of the lag between potential and current is known, or, if there is no counter E. M. F. in the circuit, it is the product of the resistance and the square of the effective current, or the product of the current and the effective voltage.

He also criticises unfavorably the new definition of the unit of capacity; formerly it was deduced from the

volt and the coulomb; now, one coulomb, with a capacity of one, requires one volt; although they are mathematically alike he thinks it is a roundabout way of defining it; one imagines a capacity as a property to hold a quantity at a given pressure, not as a pressure at a given quantity.

Regarding the American proposals, he criticises unfavorably the proposed unit of magnetizing force, which, until now, he says has always been measured either in absolute units or in ampere windings; now, a new practical unit is proposed equal to one-tenth of the absolute unit. He questions the advisability of doing this, stating that other units have been perfectly satisfactory; to introduce the new unit would be introducing useless lengthening of the calculations; what we actually have in practice are amperes and windings, and when it is required to calculate either effect it is merely necessary to combine once for all the factor 10 divided by 4π with the permeability coefficient, and not to carry it through the whole calculation; those who do not wish to do this can use the absolute unit without first dividing by 10; he is certain that the simple ampere windings will remain the practical unit, the $1.257 \times$ ampere windings will remain the absolute unit, and that the proposed unit equal to ten times the latter will not meet with favor. Regarding the field intensity and flux, he states that there is no need for anything but the absolute unit, as the quantities usually occurring in practice can readily be expressed in these units, while if the new units are used, prefixes are necessary, besides the introduction of a coefficient consisting of a power of ten; no difficulty has ever been found in considering the line of force as a unit. He calculates an example with both units showing a difference in favor of the absolute system.

Electrical Notation.—The Lond. "Elec. Rev.," June 9, in a short discussion of this subject and in referring to Hospitalier's table of symbols, makes the following suggestions: That only one instead of two symbols be used for the same quantity—this applies to L, l, for length, R, r, for resistance, etc.; objections are raised to the German and Old English characters, which are difficult to write; a suggestion is made to spell the length "meter" in the French way, namely, "metre," and to use "meter" to express recording and measuring instruments.

Work of the Congress.—For the benefit of those who are interested in the proposed work of the coming Electrical Congress, we give here a complete list of references to the discussions in the foreign journals, which have been abstracted in the Digest. As special attention was given to this subject in these columns, the following forms a complete list of references to all that has been published in the principal foreign electrical journals since the publication of the American Institute's proposals. All these references are under the division heading "Units, Measurements and Instruments":

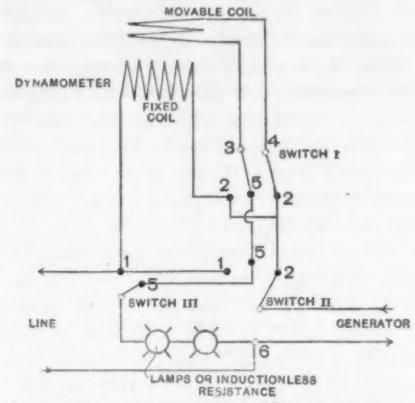
March 4, March 11, April 8, April 15, April 22, May 20, (first four paragraphs), May 27 (two paragraphs), June 3, June 17 (see also first paragraph), July 1.

Correlation of Magnetic and Electric Magnitudes.—Mr. Felix Lucas, in "L'Electricien," June 10, discusses this subject mathematically, pointing out defects in the present system, and suggests that magnetization be added as a fundamental unit to the usual mass, length and time, and that the unit for electric mass be considered a derived unit from the unit of magnetism and the unit of velocity; the hypothesis that magnetic flux is represented by the formula $L^{3/2}\ M^{1/2}\ T^{-1}$, he states, is not yet demonstrated.

Energy as a Fundamental Idea.—Mr. Carter, in the Lond. "Elec. Rev.," June 2, discusses the subject of energy as one of the fundamental units in place of mass.

Photoelectric Measurements of Light.—The "Elek. Zeitschrift," June 2, abstracts an article of Messrs. Elster and Geitel from Weid. Ann., v. 48, No. 4. In a former paper they showed that the dispersion of negative electricity from a zinc plate at a constant electrical density is proportional to the intensity of the light falling on it; on this they base a method of comparing light; as zinc is not suitable for the larger wave lengths, a surface of potassium in a glass vessel was used; a platinum or aluminium electrode was placed opposite the plate and was connected to the positive, while the plate was connected to the negative pole of a battery of 100 to 200 volts; an exceedingly sensitive galvanometer was placed in circuit and the voltage regulated so that there were no deflections, that is, no discharge of electricity when in the dark; when light was allowed to shine on the plate the deflections of the galvanometer were proportional to the intensities. The advantages of this method are that there is no approximation or personal element in the reading; the intensities must not differ very much; the sources of error are in the absorption of the ultra violet rays by the glass and the increased sensitiveness of the potassium surface with increased temperature.

Alternating Current Measurement.—Dr. Behn-Eschenburg, in the "Elek. Zeitschrift," June 2, describes the following simple method by which the current strength, the voltage and the energy can readily be measured successively with the same instrument, the latter in two different ways serving as a check to each other. The instrument used is a Siemens & Halske current electrodynamometer, and the connections and switches are shown in the accompanying diagram; the accuracy depends only on the instrument and on the calibration of the inductionless resistance. The terminals of the fixed and movable coils are disconnected from each other and are connected to the switch I, as shown; the object of this switch is merely to change the direction of the current in order to always have the same direction in the deflection; switch II connects one of the generator wires with one of the three contacts 1, 5 and 2; switch III con-



Alternating Current Measurement.

nects the inductionless resistance with either 1 or 5; for nearly constant potentials, incandescent lamps can be used between 5 and 6, as their resistance remains approximately constant under those circumstances. If E is the voltage of the generator, R the value of the inductionless resistance, then with the line circuit open and with switches III set to contact 5, and switch II to 1, the dynamometer will give the current $c = E \div R$ from which E is calculated (in the original there are several important errors in referring to the switch contacts); to measure the current C which goes to line, switch II is moved to 5 and switch III on 5; the sum of the two currents $C' = C + c$ which pass through the resistance and to line are measured when switch II is on 5 and switch III on 1; the energy A sent to line is then, according to Fleming's ampere meter method,

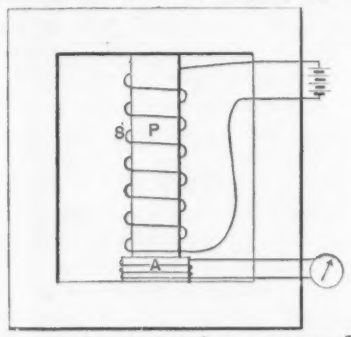
$$A = \frac{R}{2}(C'^2 - C^2 - c^2).$$

The same energy is measured directly by changing the dynamometer into a wattmeter if switch II is set to contact 2 and switch III to contact 5; the angular deflection will then be proportional to the mean value of the product Cc —that is, proportionl to $A \div R$; if the scale is divided into values designated by a, proportional to the square root of the angle, and if k is the constant of the instrument then

$$A = k^2\ a^2\ R.$$

The number of windings of the movable coil are so small that for all values of R larger than 10 ohms, the self-induction co-efficient of the coil will be smaller than $R \div 10^7$; in order to measure E the value of R must be so chosen that c is within the measuring capacity of the instrument. When the switches are properly mounted the measurements can all be made successfully in but a few minutes without breaking the circuit and without a possibility of a short-circuit.

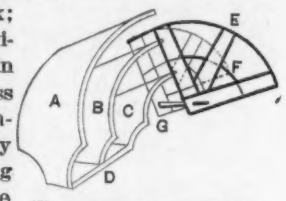
Comparing Magnetic Qualities of Iron.—Dr. Behn-Eschenburg, in the "Elek. Zeitschrift," June 9, describes a simple apparatus for measuring the magnetic qualities of samples of iron. It consists of a rectangular iron formed as shown in the accompanying cut, the sam-



Comparing Magnetic Qualities of Iron.

ple of iron P to be tested, the magnetizing coil S, and a small piece of iron A, which is wedged in between P and the iron form, thus closing the magnetic circuit; the block A has a coil of fine wire encircling it connected to a ballistic galvanometer. All the lines of force which pass through P pass through A also; if, when the piece P is magnetized by the coil, the piece A is suddenly withdrawn (which sometimes requires a considerable force reaching up to 60 lbs.), the deflection of the galvanometer will be a measure of the lines of force; if the current is first stopped and the piece then withdrawn the deflection will be proportional to the remanent magnetism. In his apparatus, the piece A was 1 centimetre thick, and is withdrawn by means of a lever; the section of the small piece was 81 square centimetres. The article includes a set of curves made with various samples of iron.

Electrostatic Voltmeter.—The English journals of June 9 describe and illustrate a new instrument of Messrs. Ayrton and Mather for measuring high voltages. The working parts are shown diagrammatically in the adjoining figures, in which A, B, C are the fixed plates corresponding to the quadrants of an electrometer, the edges and corners being carefully rounded to prevent sparking; the movable part E F consists of two thin curved aluminium plates, as shown; the voltmeter measures accurately direct or alternating voltages of any frequency; the needle is counterpoised by the hand, and is set to zero by an adjustable weight; the movable part is pivoted in jewels; the terminals, which are illustrated in the article, are cased in ebonite, so that a person cannot receive a shock; they contain a fuse of platinum silver .001 inch in diameter, inclosed in a glass tube with metal caps, enabling the fuses to be easily replaced; the disconnecting switch also short-circuits the inductors, thus bringing them to the same potential; a spark gap inside the instrument is adjusted so that in case of an abnormal rise the spark will occur at the gap and produce no damage; the scale is 10 in. long, and can, therefore, be read from a distance; the divisions are larger near the working voltages, but by shaping the inductors differently an equally divided scale can be obtained; they are made for 400, 1,000, 2,000 and 2,400 volts.



Electrostatic Voltmeter.

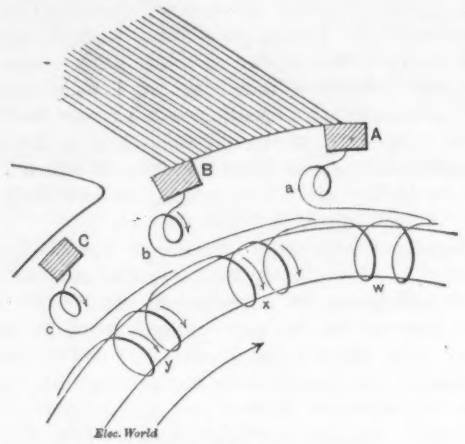
Perry's Meter.—The Lond. "Elec. Eng.," June 9, gives a description together with several illustrations of Prof. John Perry's new meter, which is at present being introduced in England, and which appears to have points of considerable merit, besides its great simplicity. It is based on the rotation of a conductor when placed in a strong magnetic field; the magnetic field is exceedingly strong and is formed preferably of permanent magnets constructed so that the north pole, for instance, forms a hollow cylinder and the south pole a solid cylinder concentric with it and inside of the hollow cylinder, leaving a deep annular space between the two, which is filled with mercury; in this is placed a revolving copper cup like an inverted claret glass; it is enameled all over the surface except at the bottom, where it is nickled; the current is led off through the shaft at the top; the opposing force is produced by Foucault currents in the copper itself; the pole faces are for this reason recessed in slots forming points where the field is very strong, alternating with others where it is very weak, the movement of the copper from a strong to a weak field generates Foucault currents; the readings are said to be constant for all temperatures and proportional at all loads. It seems to overcome many of the objections to meters and is exceedingly simple, the only possible objection being that mercury is used. The permanent magnets are magnetized originally by means of a coil placed in the interior, through which an enormous current, sufficient to make the coils white hot, if continued, is passed through for about ten seconds, which magnetizes the steel to its utmost capacity; during this process the poles are magnetically short-circuited by means of an iron armature; when thus magnetized, the permanent magnetism has a tendency to increase slightly, thus balancing the ordinary tendency to diminish; after five years the error was found to be not more than one-tenth of one per cent.

Apparatus for Measuring Insulation.—Mr. Armagnat, in the "Bul. de la Soc. Int." for May, also in "L'Ind. Elec.," May 25, describes an ingenious and apparently very practical apparatus constructed by Carpentier. It consists essentially of an ohm-meter reading directly from 0 to 50,000 ohms, made in the form of a direct reading d'Arsonval galvanometer having two coils at right angles to each other, both secured to a common shaft mounted on pivots; a small hand magneto of at least a hundred volts replaces the usual battery; the armature is drum wound and has eight sections, which is a very important point, as these machines are usually made to give a redressed alternating current, which in measuring cables having considerable capacity would give very incorrect results; one coil of the galvanometer is connected, together with a high resistance, directly to the terminals of the machine, and may, therefore, be said to measure volts, while the other coil is connected in series with the insulation resistance to be measured, and may thus be said to measure the current; both these coils act together, and according to well known principles indicate ohms; as will readily be understood, the speed of the magneto is entirely eliminated, provided only it is sufficient to generate the necessary current; that is, the reading will be independent of the speed; by the introduction of an auxiliary shunt the apparatus may be made to read up to 5 megohms. The whole apparatus, including magneto, weighs 17.6 pounds.

Resistance of Copper.—Mr. Meylan, in "L'Elec.," May 20, calls attention to the fact that while copper wire for dynamos is usually pure and of good conductivity, copper in sheets, bands and other forms is often far from pure, and when used for electrical instruments or like purposes its conductivity cannot be counted upon as approaching that of pure copper; in some samples measured he found a difference of 300%. On the other hand, he found aluminium to be uniformly good, ranging between 3.16 and 3.35 micro-ohms-centimetres.

DYNAMOS, MOTORS AND TRANSFORMERS.

Prevention of Sparking.—The discussion of Mr. Sayers' paper (see Digest, June 10 and 17) is reprinted, apparently in full, in the London "Electrician," June 2. Dr. Thompson, in his discussion, showed Mr. Sayers' device by means of the following diagram, which is much clearer than the original description. It will be seen that it consists essentially of inserting auxiliary coils a, b, c between the commutator bars and the junctions of the coils; these additional coils are on open circuit until called upon to exercise their function of creating a sufficient electromotive force to balance the self-induction of



PREVENTION OF SPARKING.

the coils which are to be reversed in passing under the brush; these coils, although not so shown in the figure, are wound on the armature. Mr. Swinburne stated that he thought the days of smooth armatures were over; the only reason why hole-wound armatures had not been used was on account of sparking, which this invention has now overcome; he did not think engineers in general had recognized the enormous advantage of hole-winding, not only on account of the mechanical protection, but also in getting rid of Foucault currents and avoiding mechanical forces on the armature wire. Mr. Sayers, in closing the discussion, said among other things that he had never found the slightest sign of heating either in the flux horn or in any other part of the field-magnet surface, provided the air space was not less than two-thirds of the width of the slot; but it is also necessary that the sum of the area of the teeth should equal the cross-section of the core in order to be sufficient to carry the induction; he agreed with Mr. Mordey that it was better not to put the whole of the excitation on the armature, and that this was specially true with small machines, the reaction in his device being greater in large armatures than in small ones.

In a communication to the London "Electrical Review," Mr. Sayers, in referring to his recent paper, states that what his commutator coils do is to reverse the armature sections close against the horns of the poles, which are strengthened by the armature reaction, instead of near the horns, which are weakened, as is usual. The result of this is that the current in the ordinary winding of the armature tends to magnetize its own field instead of to demagnetize it.

Taper of Commutator Sections.—In the Lond. "Electrician," May 26, Mr. Weymouth describes and illustrates a gauge for determining the size and taper of commutator bars; it consists essentially of two straight bars hinged at one end like the letter V, with scales marked along their length and a clamp for clamping them at any desired angle; the angle between them determines the taper of the section while the distance from the centre determines the width. The principle of the scale is based on the fact that for any number of segments from about 40 to 180, if the number of segments be divided by the corresponding numerical cotangent of the angle of one of them, a constant 6.3 is arrived at when not exceeding one place in the decimals; by simply dividing the number of segments by this constant the taper in terms of a gradiant will be obtained (if a triangle is formed by the two sloping sides and a perpendicular is drawn from one of these to the other, the gradient is the quotient of the longer perpendicular side divided by the shorter, as in railroad grades). To set the gauge, hold an inch rule perpendicular to the edge of the scale exactly at the mark denoting the number of segments and open the jaws to exactly one inch on this scale; this will open the scale to the required angle; the distance from the centre of the inside face of the commutator bar is then also given; both together will determine the exact size and taper. He calls attention to the fact, and illustrates it in a diagram, that the commutator segments mounted without insulation will assemble into a smaller circle in which all the joints fit accurately, while when mounted with insulation it forms a larger circle in which the radial surfaces of the bars do not meet at the centre. For designing a commutator he gives the following formula:

$$r = R - \frac{n \times d}{2\pi},$$

where r is the inside radius of the commutator when assembled without insulation, R the inside radius of the finished commutator, n the number of segments and d the thickness of the insulation.

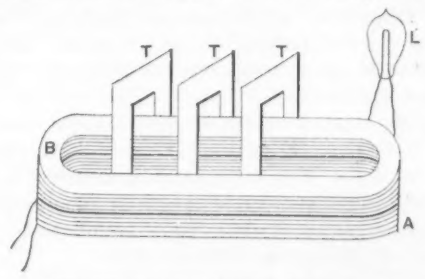
Dynamo Output.—Mr. Guy, in the installment of his serial in the London "Elec. Eng.," June 2, discusses the subject of cost, output, weight, floor space, etc., of dynamos. Roughly speaking, within 20% above and below a normal speed the cost is approximately inversely proportional to the speed; it is fairly proportional to the output when the latter does not fall below certain limits; he gives a diagram of curves for a number of different types of machines; roughly speaking, the output per weight is about at the rate of 5 to 8 watts per pound, 6 being a good average. The floor space increases approximately proportionately to the output; from 2 to 3 kilowatts per square foot may be taken as an average for dynamos above a certain size; in combined plants—that is, where engine and dynamo are on the same base plate, the latter being direct driven, the output was at the rate of 1.2 kilowatts per square foot, with a speed of 460 revolutions; in another case it was 1.26 at 485 revolutions; in a large-sized plant for central station work it was 1.72 kilowatts.

Test of a Combined Dynamo and Engine.—The London "Elec. Eng.," June 2, reprints a report of Professor Kennedy, which seems to have been made very carefully and thoroughly; the continuous current shunt-wound dynamo had an output of 123 kilowatts, and was coupled directly with a compound condensing Willans engine on the same base plate, running at 337 revolutions; the combined efficiency from the cylinder to the terminals reaches the high figure of 85.6 per cent.; the steam used per indicate h. p. was 17.4 pounds; after a six-hours' run the temperature of the interior of the armature had risen to 72° F. He gives a number of interesting curves of the data and deductions from the same.

Dynamo Design.—In his serial in the London "Electrician," June 2, Mr. Snell gives some practical examples of the calculations of dynamos; the article throughout appears to be of a very practical character, and is worth the attention of amateur dynamo builders.

Useful Formula.—Mr. Guy, in the Lond. "Electrician," June 9, gives the following short rule: 9 times the number of kilowatts per cwt. will give the number of watts per pound.

Curious Transformer Experiment.—Mr. Rankin Kennedy, in the Lond. "Elec. Rev.," June 9, describes the following interesting experiment. Referring to the adjoining figure, A and B represent the primary and secondary coils of a transformer, the secondary being joined to an incandescent lamp L; T, T, T are U-shaped transformer plates; as these plates are introduced, the lamp, of course, brightens, showing the effect of adding iron in the circuit; they will also be found to fly apart and stand as far from each other as possible; in this experiment he noticed that when the plates are forcibly brought to-



A CURIOUS TRANSFORMER EXPERIMENT.

gether the lamp drops at once to a dull red, showing that the induction is much greater with the iron parted than it is with the iron compactly compressed, even though the stampings were thoroughly insulated with paper and shellac; it shows that the distribution of the iron inside of the coils of the transformer has a considerable influence on the induction; no explanation is offered; in the hedgehog transformer the parting of the iron wires at the ends of the coils very greatly increases the induction through the coils; the above experiment shows that parting the iron inside the coils also increases the induction.

Choking Coil.—In the London "Electrician," June 2, Mr. Harrison explains graphically the following relations: A choking coil was connected in series with a resistance and the two together connected to an alternating current potential which was kept constant at 100 volts; an inductionless resistance which could be varied was then connected as a shunt to the choking coil, and it was found that when the shunt was switched in the effect of the choking coil was increased at first; as the shunt resistance was diminished the effect increased up to a maximum, and then decreased until the choking coil was completely short-circuited, when its effect was zero; a non-inductive resistance in parallel with an inductive resistance may thus be made to reduce the voltage in an alternating circuit more than the inductive resistance alone. In conclusion, he states that the E. M. F. at the choking coil terminals is out of phase with the main E. M. F., and as the current is shunted past the coil its counter E. M. F. falls, and its protecting power is correspondingly lessened, but while falling it goes more into phase with the E. M. F. of the mains, in consequence of which its protecting power is increased.

Transformer Switch.—The Lond. "Elec. Eng.," June 9, describes and illustrates a somewhat complicated switch for cutting out a transformer when no current is taken from the secondary; a clockwork and a small primary battery are used in the apparatus.

Joel Alternate Current Motor.—The London "Elec. Eng.," June 2, gives a short and very incomplete description of this motor, together with quite a number of illustrations, which, however, show nothing but the external appearance; it resembles a continuous-current motor and has the usual commutator and brushes, and it is, therefore, presumably merely a continuous-current motor with a laminated field; the field is punched out of plates like the armature (apparently as first suggested a number of years ago by Rechniewski and at present largely used in France). The motors are apparently made in small sizes only. A mention is also made of a method of making both field magnet and toothed armature cores entirely of iron wire wound upon a former and afterward worked into shape, aided by pressure. The usual claims are made that all the objections to alternating current motors have been met, but the description does not show how.

ARC AND INCANDESCENT LIGHTS.

Life and Efficiency of Incandescent Lamps.—The "Elek. Zeitschrift," June 2, reprints a table giving the values over a period of 100 hours of the candle powers and the watts of five different efficiency lamps, all of 16 c. p. at start, namely, of 1.5, 2.0, 2.5, 3.0 and 3.5 watts per candle at the start. The first died at 45 hours at 5.6 candles and 3.65 watts; the second at 200 hours at 5.2 candles and 5.24 watts; the third at 450 hours at 6.6 candles and 5.47 watts; the fourth and fifth appeared to be still alive at 1,000 hours at 8.4 candles and 5.27 watts, and at 12.5 candles and 4.32 watts respectively. The tests from which these figures are obtained were made with great care by Siemens & Halske and others. They conclude that in general only lamps of from 3 to 3½ watts per candle are to be recommended. (These figures alone, however, are not sufficient for drawing that conclusion; the price of the lamp and the cost of the energy are very important, if not essential factors.) The "Elek. Anzeiger," June 4, gives this data in the form of curves.

Light Efficiency.—Dr. Adler, in a note in the "Zeit. f. Elek.," April 1, states that Langley has found that at increased temperatures the rays of shorter wave length become the more prominent, and that the rays which possess the greatest energy approach more and more to those of the short wave lengths. Inversely, he finds from the constitution of the rays from the moon that the temperature there is from 0° C. to —20° C. The quotient of the light energy to the total energy for various illuminants is given as follows: For the candle 1.5 per cent.; petroleum lamp, 2 per cent.; Argand burner, 2.4 per cent.; incandescent lamp, 6 per cent. when run normally; arc lamp, 8 to 10 per cent.; magnesium light, 13.5 per cent. He has shown that the light which approaches most nearly to the ideal is that from a Cuban firefly, in which this proportion is nearly 100 per cent. In the incandescent gas light the ratio is given as about 13.5 per cent., and in Geissler tubes 34 per cent. If the knobs in the Hertz apparatus were as small as molecules the waves obtained would become visible.

Arc Light Versus Gas Incandescent Lights.—The "Elek. Zeitschrift," May 26, reprints a somewhat lengthy paper by Dr. Wedding containing numerous tables and light distribution diagrams, the object of the paper being to compare these two sources of light; the arc lamps used were run with currents from 1.5 to 3 amperes; the data and curves are of interest, as they represent a series of apparently very carefully made tests. In conclusion he states that gas used in a gas engine to drive a dynamo, and thence used in these arc lamps, will give 2.6 times as much light as gas incandescent lamps at their initial efficiency; as the latter diminished by 15 per cent. after 100 hours this ratio becomes 1 to 3 in favor of the electric light.

Arc Lighting.—Mr. E. Tremlett Carter begins a serial in the Lond. "Elec. Rev.," June 2, on arc lighting, in which he proposes to deal exclusively with machinery connected with arc lighting, but to limit himself to types of the most modern character, furnishing a practical (and apparently the first) engineering treatise on this subject. In the present installment he discusses the conditions of an arc light circuit and the design of the details of the circuit; a formula is given for calculating the most economical cross-section of the wire. In the issue of June 9 he discuses the subject of the modification in practice of the economic law of cross-section; also parallel systems. A table of the virtual resistance of copper for alternating currents, contained in this article, will be found in these columns under the heading "Wiring."

Electric Lights on the Atlantic.—A French company proposes to light up the course usually taken by trans-Atlantic steamers between Ireland and Newfoundland by means of ten large lightships anchored at distances of about 190 miles apart and connected with each other and with the shore by means of a cable.

Projecting an Alternating Current Arc.—In a recent lecture in Vienna, Prof. Dechart rotated a disc with openings in it before an arc lamp in a projecting lantern; if the openings passed the lamp at a rate which is non-synchronous with the alternations of the current, the various phases of the arc corresponding to the successive phases of the current will be shown on the screen at a much lower rate, or, in other words, the

projection of the arc will appear as if the frequency was very low; the various periodic stages of the arc can thus be examined and shown very clearly; by properly timing the rotating disc the apparent frequency can be made as low as one desires; in another experiment he passed an alternating current through a thin stretched wire, which cools quickly and is tuned to correspond with the alternating current; the wire will vibrate and will be dark at the point of greatest vibration and bright at the nodes, assuming that there are several wave lengths in the length of stretched wire.

TRANSMISSION OF POWER.

Transmission and Distribution of Power at Mulhause, Germany.—Mr. Desroziers, in the "Bul. de la Soc. Int." for May, discusses at considerable length the competitive proposals for that city, and includes a plan submitted by himself, in which his own continuous current dynamos are to be used, the generators being placed at the mines. In the discussion Mr. Hillairet stated that in all countries where the industrial centres are connected with the coal mines by railroad or canals it is better to transport the coal rather than to burn it at the mouth of the mine, stating that it was more economical; in France, for instance, he states the efficiency, in thus transporting the coal, was from 65% to 80%.

RAILWAYS.

Regulating Railway Motors.—The "Zeit. f. Elek." for June 1 contains the first part of an article on this subject, in which various comparative simple formulas are given for calculating the speed, current, etc., of railway motors, under various conditions. The article appears to be of a practical character.

Dead Weight.—The Lond. "Elec. Eng.," June 9, calls attention to the very great dead weight of the cars and machinery in electric traction; in a bicycle this is often reduced to 25 or 30 lbs. per person, and it therefore suggests that cars should not be designed by coach builders, but preferably by those who, like bicycle builders, have devoted their lives to the study of the reduction of the dead weight according to scientific principles.

Surface Conductor System.—Lond. "Elec. Ind." for June gives a short description, accompanied by large but not very clear diagrams, of the Wynne system, in which the conductor is laid in sections between the rails and level with the paving, the sections being connected to the conductor, contained in a conduit below the surface, only as the car passes over them; the description is not very clear, but the contact appears to be made by means of a secondary battery carried on the car, which, in sending a current from one section to the other, operates an underground magnetic switch which makes the connection between the insulated conductor and the surface sections, which contact appears to be maintained until the current for the motor ceases. The cost of construction is estimated at $7,500 per mile, that for the overhead line being given as $5,000; it is claimed that although the first cost is higher, the operating cost is less, and that a small reduction in the operating expenses more than justifies a greater original outlay.

Bessbrook & Newry Railway.—The Lond. "Elec. Eng.," June 2, gives a description of this railway, with illustrations; it is one of the few old-established lines in Ireland, having been constructed nine years ago.

Electric Railways.—The "Elec. Echo," May 27, contains a description, with a number of cuts, of a trolley line constructed by Kummer in Dresden, in which a number of details differ from the usual American practice.

INSTALLATIONS, CENTRAL STATIONS, ETC.

Secondary Accumulator Station.—"L'Ind. Elec.," May 25, contains a well illustrated description, including a diagram of connections, of the Edison secondary accumulator station in Paris. This station contains no generators, and is situated at the end of long feeders from the main station, the object being to accumulate electricity during the day and to supply it to the surrounding district during the evening, a system which has been found more economical than the direct system. The three-wire system is used, and the accumulators are connected in two series, as usual, their junction being connected to the neutral wire. There are 128 cells of about 2,500 ampere hours; the 42 cells near the middle are individually connected to two series of switches, one for the purpose of maintaining the potential for the discharging circuit constant, and the other for connecting any number of these cells with a continuous current transformer, run from the 220-volt mains, by means of which they are charged; as the charging voltage must necessarily be higher than the discharging voltage the difference is supplied by this transformer to those cells, which must be cut out in order to allow the rest to be charged directly from the mains; a diagram is given showing the connections quite clearly; Tudor cells are used; the quantity of energy of the charge and the discharge is registered by a double Thomson meter; the battery is guaranteed for ten years and the maintenance is 3.5%.

Cost of Private Electric Supply.—In an article under this heading in the Lond. "Elec. Rev." May 26, Mr. de Segundo reviews some statements made by Mr. Kapp, which have already been noticed in these columns, to show the saving effected in the first cost of the installation when the lamps are forced; also, the effect of a reduction in the cost of the lamps, which is promised in November next, when the English patents expire. He calculates special cases. He calls attention to the novel system of charging recently adopted by the Metropolitan Company, making a reduction to 11 cents per unit (kilowatt hour) consumed above 8 units per 35 watt lamp installed (the regular price appears to be 14½ cents). Among the advantages of thus charging is the discouraging of the lavish installation of unnecessary lamps in a house. He calculates an actual case, showing that by this means there would be a saving of 18 per cent. in the bill for light, and that with lamps at 37 cents, the saving would be 22 per cent. He discusses other points, pointing out among other things the great personal factor in reports of actual plants, but gives nothing new.

Day Load.—In a short article on this subject the London "Elec. Rev.," June 2, states that "it is obvious that to be commercially successful lighting and power must be kept distinctly separate from each other, and those who are endeavoring to create a demand for power purposes must be prepared to lay down separate mains." (This does not agree with the experience in this country.)

Train Lighting.—"L'Ind. Elec.," May 25, begins a description of the various train lighting installations in France. In the Northern Railway, experiments were begun in 1885; a brief description is given; accumulators are placed in each car and are charged at the stations. The total cost is .578 cent per lamp hour of 30 watts for 10-c. p. lamps, while that for oil lamps of 7 candles is .76 cent. The P., L. & M. line has been making experiments for three years and is now installing installations for 50 cars; a brief description is given; accumulators are contained on each car and are charged at the stations; Tommasi accumulators are used.

Accumulator Regulators.—"L'Ind. Elec.," May 25, contains a well illustrated description of the Trumpy automatic regulator used in the Berne installation for automatically cutting out or inserting accumulators.

Electric Installation in Switzerland.—The "Elek. Zeitschrift," June 2, reprints an interesting compilation of these installations for the years 1891-2. Most of the data is tabulated and cannot be given here. The total capacity of the alternating and the continuous current installations were as 1,600 to 1,165; there were installed 19 installations for the transmission of power and one for the distribution of power; 15 used continuous currents, 1 alternating currents and 3 three-phase currents, the total capacity being 2,380 kilowatts, for which 77 machines were used; in one of the three-phase installations 5,000 volts is used; in another 450 h. p. are transmitted 11½ miles at 13,000 volts. There are four electric railways in Switzerland, in all of which the overhead conductor is used, besides three mountain cable roads operated electrically.

Hanover Central Station.—The London "Electrician," June 2, reprints from the "Elek. Zeitschrift" the description of the Hanover station mentioned some weeks ago, including a number of the most important cuts.

Station at Leon, Spain.—The "L'Ind. Elec.," May 25, contains a description of this station.

WIRES, WIRING AND CONDUITS.

Insurance Company's Rules.—The "Elek. Zeitschrift," May 26, publishes the rules of the German Insurance Company. Among other rules, which are mostly like those in this country, it forbids the use of anything but incandescent lamps in accumulator rooms; also the use of any burning or glowing bodies in those rooms during charge; wooden moldings must be impregnated with something which will prevent them from decaying, and they can be used only in places which are continually dry; all safety fuses and their holders must be marked with the normal current, and they must be constructed so that the insertion of too large a fuse is impossible; fuses must blow at double the normal current; new installations must be started by experts, and all installations must be inspected at least once a year.

Wiring for Alternating Currents.—Mr. Carter, in his serial on arc lighting in the Lond. "Elec. Rev.," June 9, gives the following table for the virtual resistance of copper conductors with alternating currents, taken from a number of experiments made by Mr. Mordey:

Alternations per second.	Diam. of solid wire in mm.	Current in conductor.	Percentage increase of resistance.
80	10	55	Less than 0.01
80	15	133	2.5
80	20	220	8.0
80	25	....	17.5
80	40	....	68.0
80	100	....	380.0
80	1,000	....	3,500.0
100	9.0	45.0	Less than 0.001
100	13.4	98.5	2.5
100	18.0	178.0	8.0
100	22.4	....	17.5
133	7.75	32.0	Less than 0.01
133	11.61	74.0	2.5
133	15.5	131.4	8.0
133	19.36	.....	17.5

Paper Cable.—The London "Elec. Rev.," June 2, illustrates the cable shown in the adjoining cut, made by Felten and Guilleaume. It consists of four conductors lying in the four corners of a paper strip folded in the shape of a star and twisted spirally; it is lapped over with a layer of paper and then placed in a lead tube.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Neutralizing the Capacity of Long Telephone Lines by Self-Induction.—The "Zeit. f. Elek.," May 15, contains an article by Dr. Reithoffer, in which he shows, by calculation, the evil effects of the capacity of the line, and how very much the strength of the current can be increased if the condenser action is not neutralized completely, but made insignificantly small by a self-induction. In one case he shows that the current would be twelve times as great if there were no condenser action.

Transatlantic Telephony.—The British Treasury has made a grant of two and a half million dollars to develop long distance telephony, and with which Mr. Preece hopes to lay a speaking cable across the Atlantic.

Telephone.—Mr. Muller, in the "Zeit. f. Elek.," April 1, describes an apparatus by means of which two subscribers on the same line can be connected, independently of each other, with the station.

Lightning Arresters for Telegraph Lines.—The "Elek. Zeitschrift," June 2, reprints the first part of a paper by Mr. Zielinski on a series of apparently carefully made tests of the various arresters used in Germany. Illustrations of the instruments are given, as also a diagram of the connections in the test; the tests were made by means of Leyden jars charged from a Ruhmkorff coil. The paper, which is quite lengthy, is concluded in the issue of June 9, in which the results are given.

Automatic Railway Signals.—The Lond. "Elec. Eng.," June 2, gives a short description, with some good working diagrams, of a system of electrical signals lately introduced in England on a small scale in the Isle of Wight; in this the trains themselves clear or block the lines; the weight of the train depresses a spring connected to a contact in upright boxes next to the track; it operates a relay, which, in turn, moves the signal; a failure of the battery or breakage of the line allows the signal to fall to danger by the force of gravity.

ELECTRO-CHEMISTRY.

Electro-Chemical Equivalent of Zinc.—Mr. Murray, in the Lond. "Electrician," June 2, gives the results of a

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series of experiments to determine the electrical equivalent of zinc by comparing it with that of copper, which he said had been satisfactorily determined by Mr. Gray. A number of copper and zinc voltameters were connected in series under different conditions; taking the copper equivalent as .0003287 gramme per ampere per second for a current density of one-fiftieth of an ampere per square centimetre, that of zinc was found to be .0003386. (Among the different values the greatest variation was about one-half per cent.) Referring to Mr. Murray's determination, Mr. Hibbert, in the Lond. "Electrician," June 9, states that a similar determination made by him with a silver voltameter gave .0003389.

Zinc and Chlorine by Electrolysis.—The Lond. "Elec. Rev.," June 2, in speaking of the metallurgy of zinc, mentions that there is a new process of obtaining zinc and its ores, by means of which chlorine is incidentally produced as a by-product. The ore, sulphide of zinc, is roasted with an alkaline earth, producing chloride of zinc, which is electrolyzed from a cold saturated solution producing zinc and chlorine; zinc cathodes and carbon or chromium phosphide anodes are used with a current density of 10 amperes per square foot of anode surface.

Chlorine and Soda.—In the Lond. "Elec. Rev.," June 2, Mr. Andreoli concludes his somewhat lengthy discussion of the reports on the Richardson and Holland process. In the same number Mr. Richardson replies to the remarks of Mr. Andreoli. Among other things he states that the potential, six volts, which has been the cause of so much criticism, was a maximum under favorable conditions, and that it was now being reduced to five volts, including the loss in the mains, and will probably soon be brought down below three volts by the use of a depolarizer. It appears from his reply that the installation at Snodland is the only one in that or any other country which produces more than a ton of 70 per cent. soda per week. The discussion in the subsequent issue by Mr. Andreoli is to a great extent personal. In it he offers a challenge to have a set of competitive tests made and to investigate the question of originality.

Separating Antimony from Copper.—The Lond. "Elec. Rev.," June 9, mentions that in a recent process of Messrs. Smith and Wallace copper antimony is electrolyzed in the presence of tartaric acid and ammonia with very satisfactory results, the precipitated copper showing an absence of even the slightest trace of antimony.

Separation of Mercury and Bismuth.—The Lond. "Elec. Rev.," June 9, states that, according to Smith and Moyer, it has been definitely proved that mercury and bismuth

cannot be separated by electrolysis in the presence of nitric acid.

Electrolytic Painting.—The Lond. "Elec. Eng.," May 26, mentions, but does not describe, a method of copper plating metals, like a ship's hull, for instance, by painting it with insoluble salts in the form of fine powder, mixed with water, the brush being made of fine wire and the current passed from the brush to the metal to be covered. By this method, metals may also be plated with alloys, while aluminium can be plated with silver and gold. (No details are given, and it does not seem that the process can be very successful, owing to the heat developed and the short-circuiting of the electrolyte when the brush touches the metal, at which point burning is also likely to take place.)

Aluminium.—Mr. Haubtmann's article on the electrolysis of aluminium is continued in "L'Elec.," May 20; he describes the Minet and the Heroult processes.

Accumulators.—In a serial by Mr. Streintz, in the "Zeit. f. Elek.," May 15, on the theory of accumulators, he gives the following formula:

$$E = 1.850 + 0.917\,(S - s),$$

in which E is the E. M. F. at the specific gravity S of the liquid, and s the specific gravity of water at the temperature of the observation. The equation was determined from a large series of observations. His article is concluded in the issue of June 1, in which he discusses the temperature coefficient, giving an equation for the same.

Peyrusson Accumulator.—"L'Ind. Elec.," May 25, contains a short description of this accumulator; it belongs to the Plante type; the positive electrode is in the form of a cylinder, and is contained in the inside of a hollow cylinder forming the negative pole, the accumulator consisting of only two plates. The positive electrode is formed of a central rod, from which radiate thin sheets of lead .5 millimetre thick; the negative electrode is made of similar sheets of lead bent so as to expose both surfaces and united by bands and suitable terminals into the form of a hollow cylinder.

Tommasi Accumulator.—The recent type consists of a lead core and a coating of lead oxide kept in place by a perforated sheath of celluloid. It may be charged at the rate of 2.3 to 2.7 amperes per pound, and discharged at 1.8 amperes per pound. Its normal capacity is given as 11.5 ampere hours per pound, and a comparison with the Tudor shows this to be about seven times the capacity of the latter.

Wet and Dry Cells.—Mr. Walker, in the Lond. "Elec. Eng.," May 26, comments on the way cells are usually tested, stating that a breakdown test or even a continuous ringing test was not a safe guide. His plan is to connect all the cells to be tested in one circuit with a galvanometer and resistance, allowing the cells to discharge continuously at a few milliamperes, and measuring the volts and amperes once a day. He has found from experience that this test was a very sure guide, and that it could be relied upon. Of the dry cells, he finds that none approach the wet cells in staying power, although they give fairly good results for dry cells. Curves are given for a number of cells, but they are too indistinct to be of much use. The curves are very irregular, showing only a general tendency in a downward direction.

Researches with the Leclanche Cell.—A French Academy paper on this subject, by Mr. Ditte, is reprinted in "L'Elec.," May 20; he discusses the reactions which take place under different conditions.

MISCELLANEOUS.

Electrical Heating and Welding.—Mr. Watkinson, in the Lond. "Elec. Eng.," June 2, begins an article on this subject. He attributes the first experimental demonstrations of the application of electricity to the fusing together of metals to Lord Kelvin, who, in 1856, performed the experiment of fusing a bundle of wires together, as described in a paper by the late Dr. Joule, read in March of that year, on "The Fusion of Metals by Voltaic Electricity"; that author also states that he succeeded in uniting steel wire with brass, platinum with iron, etc. (The step between this laboratory experiment and the commercial welder of Elihu Thomson is, however, doubtless a greater one than the original idea.) Mr. Watkinson gives Preece's formula for calculating the fusing current for various metals; he also states that an iron wire which will fuse with a direct current of 122 amperes requires only 92 when an alternating current is used. He describes the Bernados process of welding with the electric arc, and gives its principal applications, among which is the filling up of blow holes in steel castings, for which it is extensively employed, and has saved several firms thousands of dollars; it is also used for boring and cutting, specially for girders, in which it requires one hour to do what would otherwise require ten hours; a piece of wire may, by this process, be welded to a piece of pumice stone or to a piece of asbestos.

In the issue of June 9 he describes the Coombs wood process, in which the arc is successfully used; a table of tests is given for different irons welded by this process and by the ordinary blacksmith process, showing that the efficiency of the electrical weld averages 88.5 per cent., and of the hand weld, 80.8 per cent. The Thomson incandescent method and the Coffin method, which is a combination of the other two, are described, a large number of illustrations being given.

Electric Cooking and the Load Factor.—An article under this heading in the Lond. "Elec. Rev.," May 26, reviews the subject of electric cooking, but gives nothing new. From 75 to 80 per cent. can be guaranteed as a return of the total heating energy of the current. No difference has been noticed between alternating and continuous currents. One pint of water can be raised from 15 degrees C. to 100 degrees by 75 watt hours, showing an efficiency of 73 per cent. A tailor's goose weighing 15 pounds takes 4 amperes at 100 volts, therefore costing four cents per hour. The article states that the cost must always be far above that of gas. It says nothing about the load factor, except that central stations will do well to advocate the introduction of electric cooking. With theoretical efficiency the cost of electric cooking, it states, will be about ten times the cost of gas, taking gas at 62 cents and electricity at 6 cents.

Electric Cooking.—A correspondent to the Lond. "Elec. Rev.," in the issue of May 26, discusses the figures given by Mr. Dowsing, namely, that a quart of water requires about 3½ amperes for 10 minutes, and shows that this is equivalent to 210 heat units while theoretically it requires 375; this speaks very badly for Mr. Dowsing's figures and throws a doubt on the other data which he gives. (He probably meant to say a pint instead of a quart.)

Several correspondents to the Lond. "Electrician," May 26, call attention to this same error of Mr. Dowsing. Mr. Binswanger, a manufacturer of cooking apparatus, states that the new kettles require 1,000 watts for 3.8 minutes per pint, which is an efficiency of about 90 per cent. He gives data of a test with one of his ovens requiring 9 amperes at 100 volts. The temperature for periods of 5 minutes were 12, 49, 108, 180, 225 degrees C. He has found that the enamel used in the American method cracks, and thereby fails in its function. He uses a cement which is applied without baking, and allows the use of an extremely thin film. Mr. Fletcher, in discussing the same subject, says that one cubic foot of London coal gas has a heating power of 660 units, of which over 600 are obtained in actual work in many bath heaters. He concludes that one cubic foot will give at least the same energy as 3½ amperes for 10 minutes.

An English firm, in the Lond. "Elec. Rev.," June 2, calls attention to the fact that an incandescent lamp run on a low efficiency so as to be durable is, for many purposes, the cheapest and most efficient electric heater that can be devised; it becomes hot and cold again almost instantly, having no storage capacity; a 50-c. p. lamp taking 170 watts will heat one pound of water from 20 degrees C, to 100 degrees in twenty minutes; they call attention to the fact that the efficiency of the heating apparatus depends considerably on the rate at which the energy is set free; strong currents for shorter periods are, therefore, more efficient.

Laboratory Furnaces.—The Lond. "Elec. Rev.," June 2, reprints an abstract of a paper by Mr. Borchers, a leading German authority on electro-metallurgy, from the "Zeit. f. Ang. Chemie," 1892, page 133. Seven cuts are given of various electric furnaces, but they appear to be suggestions as distinguished from apparatus which has stood the test of practical application; one form resembles somewhat the Moissan furnace with horizontal carbons; in another there is an iron crucible, and a third is for very high temperatures. (In this form the crucible is supported by light metal springs, which, it seems to us, would be destroyed very quickly by the high temperature of the crucible.) In the editorial article the belief is expressed that Mr. Borchers' apparatus will replace all gas furnaces for metallurgical work.

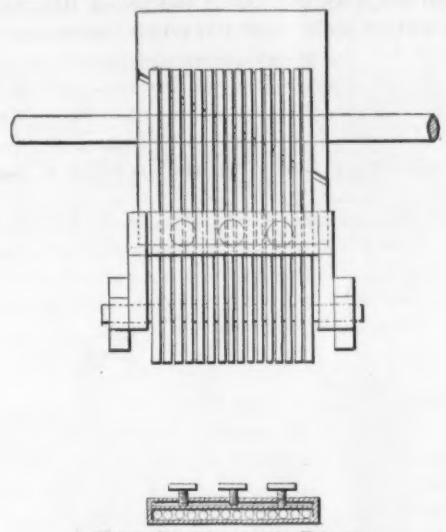
Electric Furnaces.—The Lond. "Elec. Rev.," May 26, summarizes briefly the results obtained in the reduction of the refractory earths, all of which has already been noticed in these columns.

Revolution Counter for Ship Shafts.—The "Elek Zeitschrift," June 9, contains a description, accompanied by good illustrations, of an apparatus devised by Messrs. Siemens & Halske.

A New Commutator Brush.

Mr. Karl Koch, the wire manufacturer of Hohenlimburg, Germany, has recently patented another commutator brush whose manufacture has displaced that of the woven wire brush identified with this firm.

Fig. 1 is a front view of the new brush and holder as fitted to the commutator of an electrical machine, and Fig. 2 is a cross-section of the same. The brush is constructed entirely of small metallic tubes inserted in a suitable holder; the form of holder shown is pivoted and the tubes kept against the commutator as indicated with an adjustable force, permitting the tubes to be always kept against the commutator notwithstanding wear. It is claimed that the improved brushes are much more resistant to wear than those of usual construction having the same contact surface. It is, therefore, possible to press the brush more forcibly against the commutator and thereby increase the conductivity, as it is well known that the chief electric resistance is found in the place of



A NEW COMMUTATOR BRUSH.

contact. Another advantage is that the brush is easily cleaned, as it is sufficient to blow air through the tubes in order to remove dust and the like.

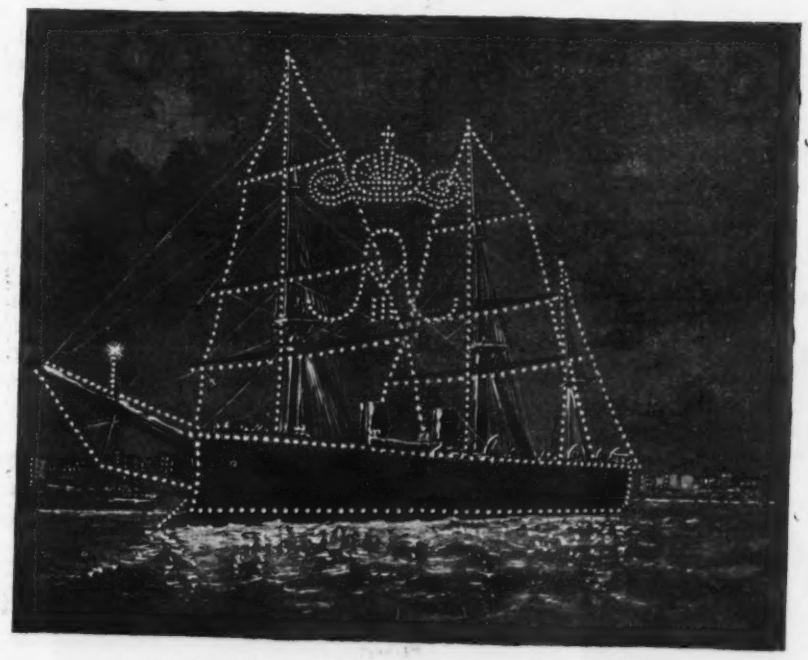
Electric Decorations on War Ships.

The decorative illumination of war vessels by means of small incandescent lamps was a new wrinkle introduced with great effect during the recent Columbian celebrations in New York, and the beautiful scene at night, when the vessels were outlined in light against the black background of the night, was not the least attractive part of the famous naval display.

The occasion of the birthday of the Czarewitch gave the Russian Admiral a chance to distinguish himself, and offer to the expectant public a view of his vessels at once beautiful and effective. The cut gives some idea of the illumination of the "Dmitri Donskoi." The vessel was outlined in lamps from truck to water line, while between the masts was suspended a brilliant reproduction of the initial letter of the reigning Romanoff's name, surmounted by the Russian Imperial crown, formed of scintillating lamps of different colors. In the position on the bowsprit usually occupied by the "jack" gleamed a small bright star.

The "Rynda's" decorations consisted of the crossed Russian naval and American flags, surmounted by a five-point star.

The work was done by the lamp department of the General Electric Company, under the immediate supervision of Messrs. G. M. Baillard and C. A. Gundaker, while Lieut. Andre de Pekrowsky, of the "Dmitri Donskoi," himself a skilled electrician, lent valuable aid in effecting the installation.



ELECTRIC DECORATIONS ON WAR SHIPS.

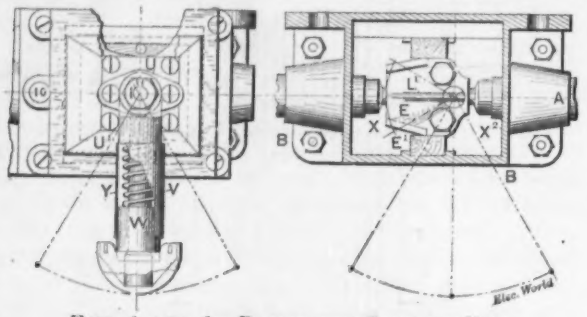
A New Conduit Electric Railway System.

A new conduit electric railway system is being tried at Coney Island on a quarter mile experimental track, which possesses a number of interesting features.

Briefly stated, the system consists of a shoe projecting from the bottom of a car into a conduit, and a series of contact boxes connected with the line and placed at equal intervals along the side of the interior of the conduit. Levers projecting from the boxes are moved when the shoe encounters them, which switches on the current from the line; the current then passes through the end

of the lever by sliding contact on the metallic side of the shoe and thence to the motor. At Coney Island a metallic return is used, so that there are boxes on each side of the conduit, as shown in Fig. 5, and the shoe is double. It will be noticed that the main feature of the system is that the line is completely insulated within the boxes except in those opposite the shoe, which are never more than three in number; as a consequence any leakage will only occur through these during the brief time they are connected with the line.

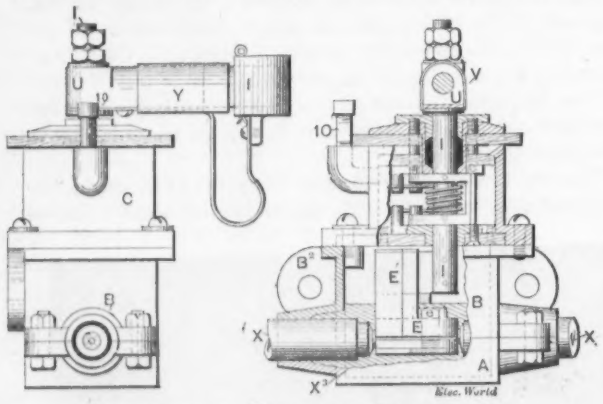
In Fig. 5 are shown the shoe and boxes, the operation of which will be plain from the above description. The



FIGS. 1 AND 2.—DETAILS OF CONTACT BOX.

shoe consists of two metallic strips 7 feet 6 inches long and about 4 inches wide, which are secured to and insulated from a central piece of flexible wood, which is in turn suspended from the bottom of the car; the two metallic sidepieces are connected to the positive and negative terminals, respectively, of the motor, as shown. The construction of the shoe is such that it is flexible and will readily bend to take any curve, and it is secured to the car so that, while it can have no fore and aft motion, yet if the car is derailed it is free to move laterally and will be released and drop into the slot if the lateral displacement is greater than the width of the shelf which supports it. This is an important point, as a derailment cannot injure the shoe. During an exhibition trial before representatives of the technical press the car was accidentally derailed and demonstrated the truth of this claim, as it merely fell from the bottom of the car into the slot and was not at all injured.

The contact box is shown in Figs. 1, 2, 3 and 4. Referring to Fig. 4, X is the line conductor, which at Coney Island is sheathed with lead; it passes into the bottom of the box through a stuffing box, and, as shown in Fig. 1, is there stripped of its insulation and made fast to the piece E, which has two vertical projecting lugs, one of which is marked E′ in the same figure. The lever Y (Fig. 3) is secured to a vertical stem I (Figs. 2 and 4), on the lower part of which, and between the two



FIGS. 3 AND 4.—DETAILS OF CONTACT BOX.

lugs E′, is a brush, also shown in Fig. 5. In the upper part of the box is a spring which keeps the lever Y, except when in contract with the shoe, at right angles to the side of the box, and the brush midway between the two lugs. When the lever comes in contact with the shoe it is shoved to the right or left, according to the motion of the car, which brings the brush in contact with one or the other lug, thus making electrical connection with the line; the current then passes from the line, through the lugs to the brush, the stem I, the lever Y, and thence to the shoe, and finally to the motor, returning in reverse order through the other side of the shoe and box on the opposite side of the conduit to the return conductor.

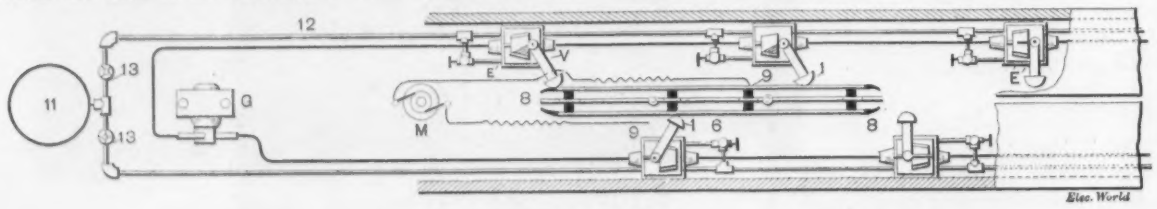


FIG. 5.—GENERAL VIEW SHOWING CONTACT SHOE AND BOXES.

The lever connection Y, Fig. 2, is hollow, and by means of the spring shown the contact end is allowed some motion, and thus also kept in flexible contact with the shoe. The lower or brush part of the contact box is separate and electrically insulated from the upper or spring mechanism part, as shown in Fig. 4. Both the lower and upper boxes are kept filled with a heavy petroleum for insulation, and any leakage provided for, as shown in Fig. 5, through the piping 12, leading from the reservoir 11.

From the above description it will be seen that the line connection in the lower part of the box is thoroughly insulated, as well as the lever mechanism. Should there be, however, any fault in the insulation of the latter, any leakage would only occur while the contact lasts.

The system is owned by the Universal Electric Company, and was installed by Mr. Stetson, the electrical engineer of the company, and his assistant, Mr. Brown. The details were invented and perfected by Messrs. Green, Dale and Van Nuis.

Electric Arc Welding and Metal Working.

In electric arc welding the principle involved consists in the application and concentration of a high degree of heat upon a comparatively small area by means of the electric arc. As the temperature of the arc may be considered practically constant, various heating effects are obtained by varying the quantity of heat suitably to the material operated upon.

Numerous methods of utilizing the electric arc in welding and metal working have been invented by Charles L. Coffin, of Detroit, who has made a specialty of this branch of electricity, and we illustrate several of the machines devised by him. The welds made by the processes devised by Mr. Coffin are uniform and homogeneous in character, and the material is in no wise altered or modified. The welds exhibit very little scale or oxidation, and, as the result of a large number

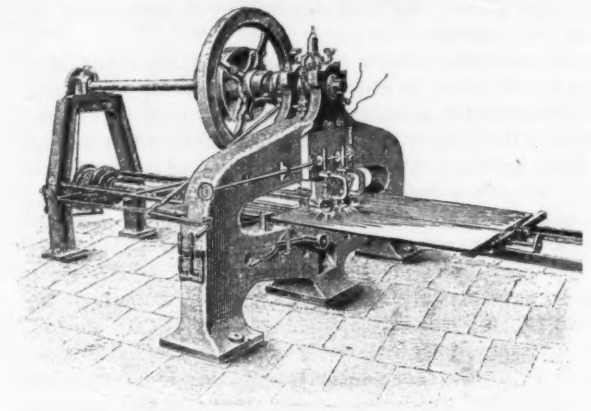


FIG. 1.—ELECTRIC ARC WELDING.

of tests, show the very remarkable average of 98.6 per cent. of the original tensile strength of the material.

Fig. 2 shows a machine for welding rods, bars, axles and butt-welding tubes. This machine is designed to employ the radiated heat of the arc for heating the metal. At no time during the welding operation is the metal in the arc or in the electric circuit. The axle or bar is placed in the clamps and adjusted to alignment; the lever at the right is raised, opening the furnace; the lever at the left brought forward, which throws the bar into the furnace and simultaneously closes the same. The clamps are rotatable and adjustable in regard to one another, thus admitting of irregular forms being held in alignment at the weld. When the material has reached the welding point, which is readily determined either by the time of exposure in the furnace, by the appearance of the metal, or by the tacky feeling when the clamps are slightly separated, or both, the hand wheel is thrown and the weld upset or securely closed at the joint by means of the right and left screw-threaded shaft carrying the clamps, the furnace is opened and the bar withdrawn, the clamps opened and the bar removed.

The clamps are adapted to hold round or square bars of any diameter or dimensions from ⅛ inch up to 1½ inches. Sets of clamps for all diameters and cross sections are supplied with each machine, it being but the work of a few minutes to remove and replace a set of clamps. The apparatus is also provided with an electrical arc regulating apparatus, rendering any attention on the part of the workman unnecessary. An automatic timing device and a telltale, adjustable for any desired amount of "upset," makes the welding operation nearly automatic and independent of skilled labor.

Another type of machine is made for welding straps, bars and half-round iron. This machine has a hand regulator for the arc in place of an electrical regulating device. Sets of clamp blocks are provided for various shapes and cross sections. In operating the machine the mode of procedure is much similar to that of the foregoing. This apparatus will handle straps from ⅛ inch thick and 2 inches wide up to ½ inch thick and 2 inches wide. A machine built on this type, but much heavier, and with additional accessories and with a pneumatic hammer attached, is designed to weld bridge straps of 6-inch width, 1 inch to 1½ inches thickness.

Another machine made is a tire welder. This machine is provided with adjustable clamps, a telltale for upsetting, an automatic timing device, a heat regulator and a hand regulator for the arc. The machine will handle tires from ⅛ inch in thickness up to ½ inch in thickness, and widths varying from ½ to 1½ inches; half-round or special forms of tires can be as readily welded. Tires of any diameter down to 16 inches may be welded or shrunk. Additional clamps and appur-

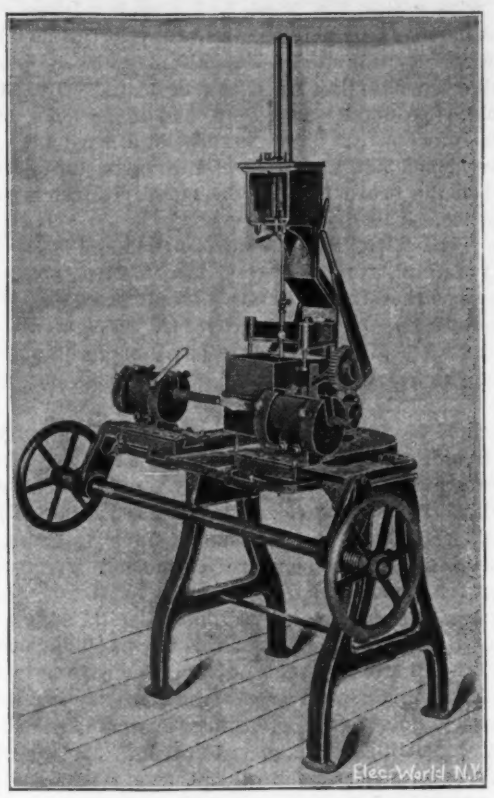


FIG. 2.—ELECTRIC ARC WELDING.

tenances render the machine available for welding hub bands, nail keg hoops, barrel hoops, and rings and hoops of ordinary diameters in round iron of various gauges.

This machine will handle tires up to its maximum capacity, i. e., tires ½ inch × 1½ inches, at the rate of one tire per minute, it is claimed, with a consumption of less than 3 h. p. of energy. A special electric generator is not required, as the welder may be run from any arc or incandescent circuit, or from the isolated lighting plant generally found in all well equipped shops, thus reducing the expense to a minimum.

In this method of tire welding the short circuit factor, which is of such importance in the incandescent method of electric welding, does not enter.

A machine has recently been perfected, on which, with a consumption of 25 h. p., 36 tires per minute can be welded, each tire being exactly to the same gauge and diameter when finished. Large agricultural tires of ¼-inch gauge, 1-foot face, any diameter, can be welded at the rate of three per minute. These welds have been tested for tensile strength, and showed remarkable excellence. Eight welded bars showed an average tensile strength of 47,719 pounds per square inch, the average tensile strength of the same bars unwelded showing 49,264 pounds per square inch.

In Fig. 1 is shown a machine for the welding of sheets or plates of metal.

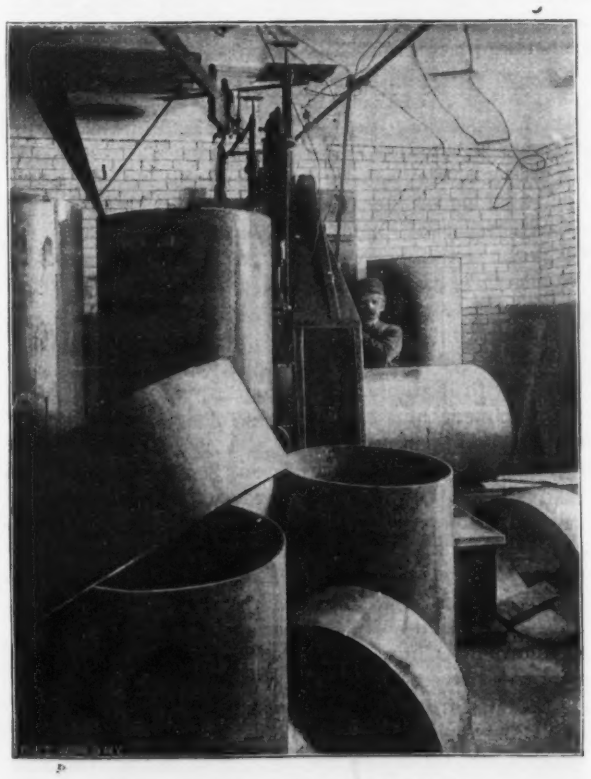


FIG. 3.—ELECTRIC ARC WELDING.

In Fig. 3 are shown specimens of tubes welded by this process. The tubes and sections can readily be welded in metal from No. 10 gauge or less up to ½ inch in thickness, and with a rapidity of from 2½ inches per minute up to 3 feet per minute, or faster in proportion to the power employed.

Serviceable Primary Batteries.

An invention, which, though simple in itself, is destined to popularize batteries, both of the closed and open circuit types, because of its simplicity and effective eradication of an old evil, has just been adapted to both closed and open circuit work.

It consists of a non-corrosive separable connection for the carbon element, and provides also for the equalization of the internal resistance by withdrawing current uniformly from all points of the carbon surface. The great simplicity of the means and method creates surprise that its discovery should have been left to this late day, since corrosion at the point of the metal connection to the carbon element has been a fruitful source of difficulty with all cells employing carbon. That such corrosion with consequent increase of internal resistance can be overcome is shown by the accompanying description of the invention of M. M. Hayden, and its merits are proven by the fact that it will be used by two firms, Bryan, Marsh & Co., employing it upon all forms of the Kolon primary battery for closed circuit work, while the Law Battery Company

FIGS. 1 AND 2.—SERVICEABLE PRIMARY BATTERY.

will make a special cell, embodying its features for open-circuit work. Its application is restricted to these two concerns by contracts with the inventor.

The invention, which was recently patented, consists in screwing or interlocking to the carbon element a carbon button or cover made of a dense impenetrable carbon (not adapted itself to be an element of a cell), impervious to the action of any electrolyte, and carrying the metal connection from this button or cover instead of the carbon element itself. By this combination it can be readily seen that the point of contact between the electrode and the separate piece of carbon can be immersed indefinitely in the strongest acid without affecting the connection in any manner. To offer no possibility of the carbon cover being affected by long years of use, however, this dense carbon has its minute pores effectually sealed by chemical treatment, thus rendering it stable for all time.

We illustrate herewith the adaptation of the invention to the Kolon primary battery, when it is designed to run motors, fans, sewing machines, small electrical plants, or to apply it to medical and dental uses, etc., together with other improvements in mechanical construction which should add in the extension of the popularity which the Kolon already enjoys. Fig. 1 shows the carbon cup with the carbon screw cover re-

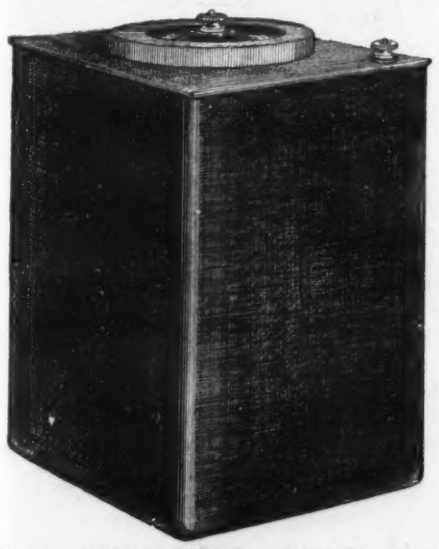


FIG. 3.—SERVICEABLE PRIMARY BATTERY.

moved, exhibiting in itself the solution of a difficult mechanical problem, as the carbon cup is made with a perfect thread in sizes as large as 6½ inches in diameter. As illustrated, the metal connection is taken from the middle of this carbon screw cover, and is consequently perfectly protected from all influences of corrosion from within, while the attachment of the metal to the carbon is made below the surface, both being threaded for this purpose. The carbon cup contains the depolarizer.

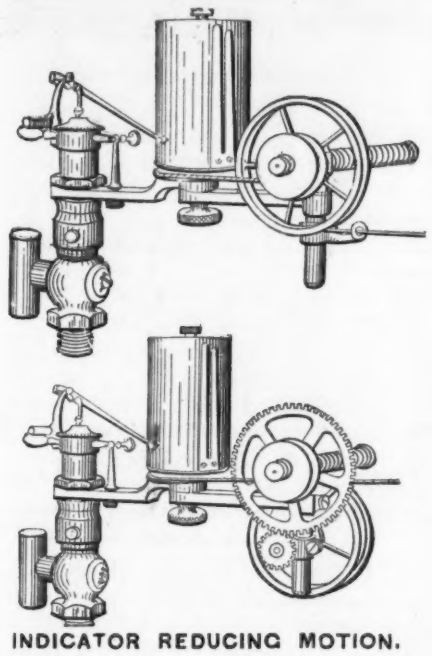
In Fig. 2 it is shown suspended by cover within a glass cell surrounded by a cylindrical zinc and acidulated water.

In Fig. 3 a larger type is exhibited within a hard rubber jar. The mechanical completeness and compactness can be readily seen and appreciated.

Bryan, Marsh & Co., of 136 Liberty street, are now offering ten types of battery, all of which contain this separable, non-corrodible carbon connection. They claim not only this advantage, but also that of higher efficiency, simplicity, and higher rates of discharge than could formerly be obtained, combined with more rapid and economical methods of manufacture than have heretofore been possible.

Indicator Reducing Motion.

A convenient reducing motion for indicators has recently been placed on the market by Hine & Robertson, 68 Cortlandt street, New York, which can be used on any of the usual forms of indicators.

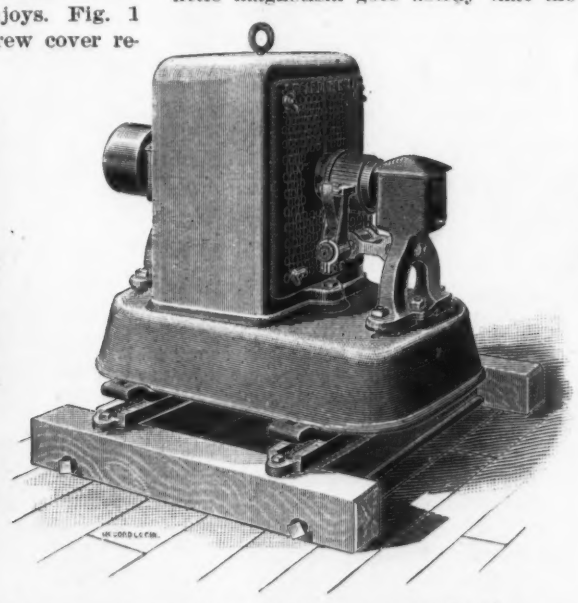


INDICATOR REDUCING MOTION.

The cord guide of the indicator is displaced and the cord run directly onto the drum from a wheel on the reducing motion, as shown. For strokes up to 26 inches the arrangement shown in Fig. 1 is used, and for longer strokes that shown in Fig. 2 is substituted.

The Card Ironclad Motor.

The new motor, illustrated below, now being brought out by the J. F. Card Motor Company, of Cincinnati, O., is intended to supply a rapidly growing demand for a first-class working motor at a reasonably low cost. No attempt is made in the design at ornament or finish, and no work put on it unless necessary, and then of the very best. Great care has been taken to combine in the most effective manner the essential working parts and make them easily accessible; no pains have been spared to make the parts lasting and operative with minimum attention. As will be seen from the illustration, the motor is of the well known ironclad type. The field core is cast in one piece, and the exciting coils made to embrace a large portion of the armature at top and bottom, making a very short and effective magnetic circuit. In fact, so little magnetism goes astray that the smallest piece of



THE CARD IRONCLAD MOTOR.

iron will not be attracted to any part of the external surface. The armature core is laminated and slotted and wound Gramme style. Mica is used for insulation both in the slots and the inside of the ring, and great care taken to secure thorough and lasting insulation throughout. The connections to commutator are made straight out and in the simplest manner possible. The commutator segments are of the best copper, separated by mica, and a sufficient number used to insure sparkless running. Carbon brushes and a novel brush holder convey the current to the armature. Since no lead to the brushes is necessary and no changes for varying loads, the conventional yoke has been discarded as superfluous, and a simple permanent fastening provided that can never get out of order or become displaced. The carbon brushes feed end on and are not to be touched so long as enough is left to conduct the current. The open ends of the field core are covered by perforated cast iron plates, protecting the field coils and armature from injury, and in case of use in very dirty places may be covered with paper or cloth inside, making it practically dust-tight.

The commutator is covered with a neat iron casing (not shown in cut), provided with a lid for convenient inspection. Generous journals with bronze, ball and self-oiling bearings, having two rings on each, insure long life and cool running to that important part of the apparatus. The iron case is not too heavy, but very rigid, and the sliding frame provides a good foundation for all. It is intended by this company to confine work to the manufacture of four sizes, 5, 10, 15 and 25 h. p., wound for any voltage.

The Burgess Soldering Furnace.

The Burgess Soldering Furnace Company, of Columbus, O., has added an improvement to the "regulating valves" of its Gem furnaces called the stop on the spindle. The accompanying illustration will give a good idea of this

BURGESS SOLDERING FURNACE.

mechanism, and render any extended description unnecessary. In the future the Gem furnaces Nos. 3, 4, 5 and 6 will be equipped with this apparatus.

The "Aluminium-Iodine" Portable Testing Battery.

The testing battery illustrated herewith is a new form that has been thoroughly developed in the experimental department of Queen & Co., Incorporated, Philadelphia, and is now being placed on the market by this company.

In chemical composition the "aluminium-iodine" cell is claimed to be quite different from anything heretofore known, and possesses important features, the most essential of which is the high electromotive force. Each one develops a voltage of 1.4 volts, which is fully 50 per cent. more than that of an ordinary chloride of silver cell. The effect, as will be seen, is that 50 "aluminium-iodine" cells have the same efficiency, as far as voltage is concerned, as 75 of the other type, so that great economy in first cost results.

The cells are prepared with great care, and those used in the laboratory of Queen & Co. for months past

PORTABLE TESTING BATTERY.

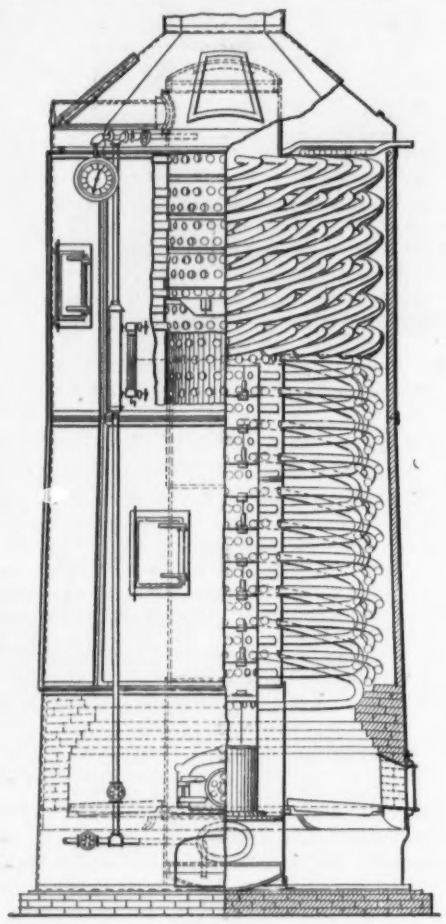
have, it is claimed, shown remarkable constancy and long life. There is no danger of explosion or leakage, and local action is practically eliminated, so that when not in use there is no injurious waste.

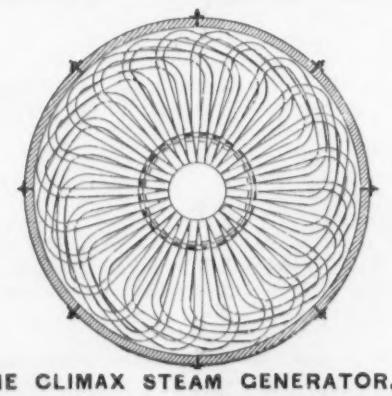
The cells are mounted in handsome polished mahogany cases in sets of 50, more or less, as desired. A battery of 50 cells gives 70 volts E. M. F., which is quite sufficient for all ordinary work. Electrical engineers, in testing the insulation of submarine or underground cables often require 200 or 300 volts to secure proper sensibility in results, and a battery of as many cells can readily be prepared if desired.

The "Acme" portable testing set, also manufactured by Queen & Co., contains twelve "aluminium-iodine" cells, which they propose to use entirely in place of the regular "chloride of silver" form.

The Climax Steam Generator.

Among the interesting exhibits in the Annex of the World's Fair are several Climax boilers of the type we illustrate, two being of 500 h. p. and one of 1,000 h. p. These boilers, which are manufactured by the Clonbrock Steam Boiler Works, 564 Smith street, Brooklyn, N. Y., consist of a series of bent tubes expanded into a vertical central shell and surrounded by a refractory lining. The tubes are so bent that one end enters the vertical cylinder considerably higher up than the lower end, but not vertically above it, as may be seen in the plan view by following one of the tubes. To assist circulation, a second cylinder, with a closed bottom and open top, is used inside the outer shell, and the lower end of each tube is connected with this by a short piece of tube; the joints of the small tube and inner cylinder need not be steam tight. The water is fed into the central drum, any sediment being deposited in the lower end removed from the fire, passes into the lower end of a tube and comes out of the upper end outside the inner cylinder, into which the water finally passes for another course; the steam disengaged is made by a series of diaphragms to pass through the upper tubes and is thus dried. There are



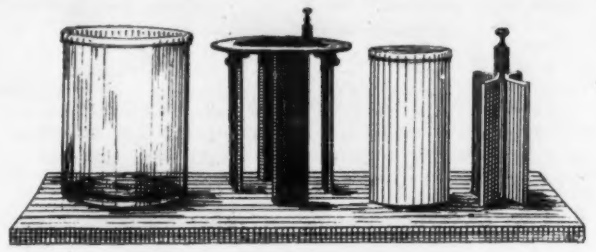


THE CLIMAX STEAM GENERATOR.

no screw, metallic, ground or packed joints, no cast metal is used, any tube may be easily removed and replaced by another, and the circulation is exceedingly effective.

A New Primary Battery.

The Hewett Voltaic Electric Company, located at 42 Montgomery street, Jersey City, N. J., is the manufacturer of a new primary battery, which they claim to be far superior to anything thus far on the market. The cell consists of a six by eight glass jar and a four by eight porous cup, 3⅜ pounds of the best five per cent. alloyed mercurial zinc and a casting from which hang four 2½-inch carbon plates. The cell is designed to be used especially in connection with the Hewett voltaic compound, which is put up in dry form and when dissolved in water is ready for immediate use. A solution produced by this compound is claimed to be far superior to any acid solution on the market to-day. The compound, being dry and packed in tin cans, can be very conveniently shipped, and hence the expense and inconvenience avoided attendant upon the shipment of acid solutions. The battery has been successfully applied to the running of small incandescent lamps of from 6 to 12 c. p., for lighting carriages, portable lamps, etc. It is especially adapted for the running of ventilating fans, three cells, it is stated, being sufficient to run any six-volt motor, with a ten-inch six-bladed fan, with a speed of 1,500 revolutions per minute, at a cost not exceeding two cents per hour. Another great advantage claimed for this battery charged with the compound is the fact that there is no consumption of material when the battery is idle. These batteries, it is stated, have been left on open circuit for several weeks at a time without having lost any energy whatever. The compound can be used in



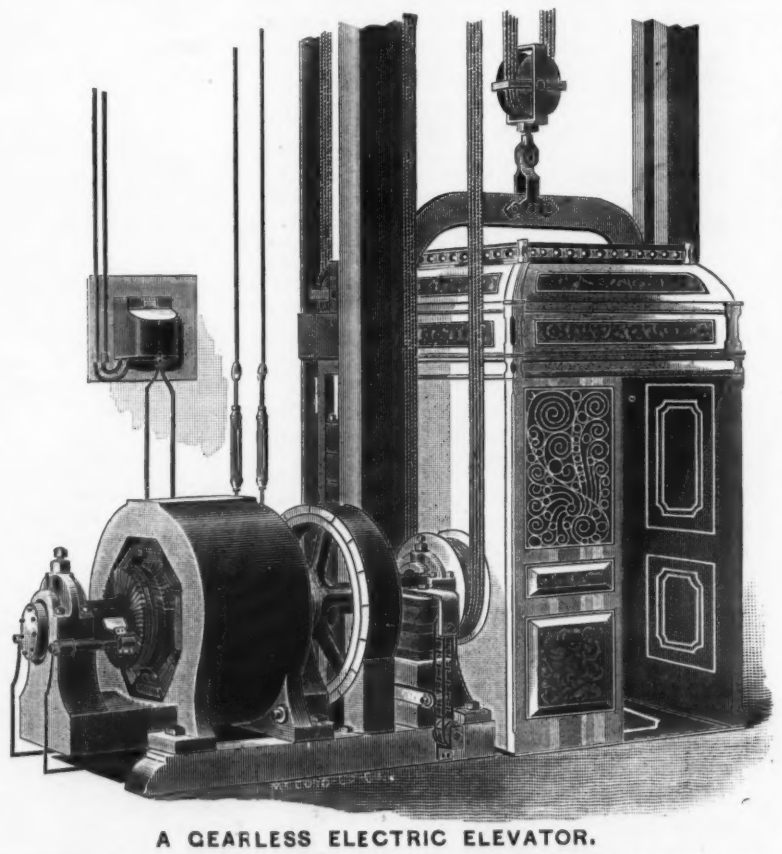
A New Primary Battery.

any zinc and carbon battery of either single or double fluid. This same company has also in preparation a new open circuit battery, which, it is claimed, will excel anything on the market at present, and which will shortly be introduced to the public.

Two compounds are used in connection with the above battery, named electrocite and electropole. Electrocite, which also replaces the ordinary exciting fluid in any cell employing zinc and carbon elements, has no corrosive fumes, and, as stated before, no action on open circuit, while it gives an electromotive force of 2.1 volts. The use of electropole is also advised, as this compound keeps the zinc element clean, increases the life of the battery and obviates reamalgamation. The battery and compounds are the inventions of Mr. Gardner Hewett, a well known electrician, late of Boston, Mass.

A Gearless Electric Elevator.

The small space occupied by electric elevators, their smooth action and a number of other important advantages have been well recognized by the public,



A GEARLESS ELECTRIC ELEVATOR.

notwithstanding the many crude machines that have been placed on the market; and the cheapening of power that will result when central station managers more generally see the necessity of a full day load will doubtless cause their exclusive adoption where electric power is available. These considerations and others have been acted upon by inventors and by manufacturers with the result of great improvements over the early forms, and we illustrate one of the most recent, manufactured by the Cincinnati Electric Engine Company, 12 East Third street, Cincinnati, O.

The most important feature of this elevator is that gears are entirely eliminated, thus greatly reducing friction, and obviating the expense of renewals of worms and worm wheels, on account of the great wear to which they are subjected. Other advantages are the prompt and easy manner in which the elevator starts and the smoothness of the stops, part of which is due to an absence of excessive inertia. Loads are lowered at desired speeds without consumption of current or use of brakes, and slipping of the brakes is not necessary to secure smooth stops.

While a cursory glance at the illustration might lead to the impression that a slow-speed, multipolar motor is the prime factor in the elevator, its utility, we are informed, is entirely dependent upon auxiliary devices, which constitute the vital elements of the system, but the details of which, owing to patents pending, cannot be described at present.

Improved Cable Supporter.

A device which is easily and quickly applied, and which should prove very useful for the suspension of aerial telephone and telegraph lines and electric cables is shown in the accompanying illustration, and is manufactured by O. N. Bender & Co., 34½ Friendship street, Providence, R. I. It is made either in brass or zinc and is warranted to be absolutely secure. One single hanger will support 150 pounds, and it is claimed it will not slip or slide on the cable. From the illustration the simple method of attaching it can readily be seen.

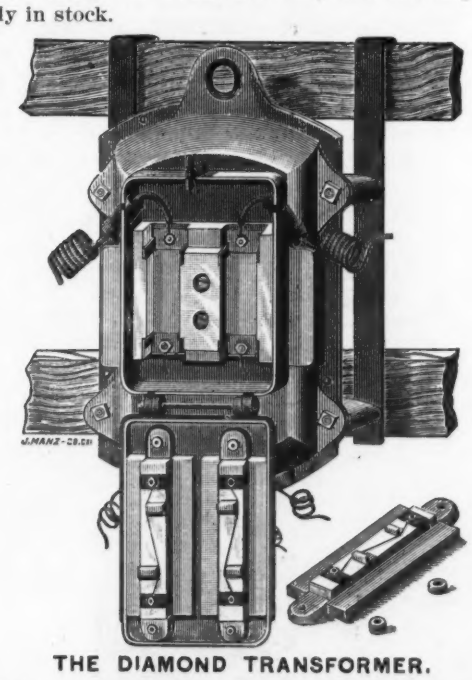
Improved Cable Supporter.

The Diamond Transformer.

The main points to be attained in a transformer are efficiency, regulation, safety, convenience and economy in repairs, and in the Diamond Transformer, manufactured by the Diamond Electric Manufacturing Company, Peoria, Ill., it is claimed that these qualities are combined in as high a degree as possible. No attempt has been made to secure one quality at the expense of another, but a compromise made which results in a well-balanced transformer, with nevertheless an efficiency at full load that varies from 90 per cent. for 5-light transformers to 96.5 per cent. for those of 100 lights. The iron and copper losses have been so reduced and balanced as to give the best working results, and the regulation is claimed to be much superior to that of other transformers.

Owing to the excellent insulation employed in this transformer, it is perfectly adapted to the Brush and all systems using high potential current on the primary. As it has more iron in the secondaries than is usually employed, it is particularly suitable for systems of low alternations, such as the Siemens & Halske, Brush and Royal.

In the Diamond transformer is used such insulations as mica, porcelain and asbestos, together with a special insulation varnish that does not deteriorate with age. The insulation resistance is not only very high, but is permanent. A special and very important feature is that a coil can be replaced. These coils are wound on a frame ready for immediate use, and are kept constantly in stock.



THE DIAMOND TRANSFORMER.

Although, as before explained, the Diamond transformer is not made so light in weight as to endanger a high temperature, the case is, in addition, thoroughly ventilated by apertures at the top and bottom, so that the air may have free circulation through the interior, which aids materially in keeping the coils cool. These apertures are so arranged as to make it impossible for rain or sleet to enter the case. The transformer is easily and quickly convertible from 50 volts to 100 volts on the secondaries.

The fuse box and fuse plugs are made entirely of porcelain. By simply opening the door of the fuse box the fuse plugs are disconnected from the live wire, and the fuses can be replaced with perfect safety. The fuse plugs are self-supporting on the fuse box door, and both hands are at liberty to replace fuse wire. Fuse plugs may be taken off and new ones inserted in an instant without the aid of tools. All fuse blocks are interchangeable for the different sizes of transformers. To make it impossible for the blowing of one fuse to effect the other by heat each fuse is placed in a separate compartment.

Davidson Artesian Well Pumps.

The improved Davidson artesian well pump, manufactured by M. J. Davidson, Brooklyn, N. Y., in construction is a radical departure in some ways from the generally accepted form of artesian well pumps, a dis-

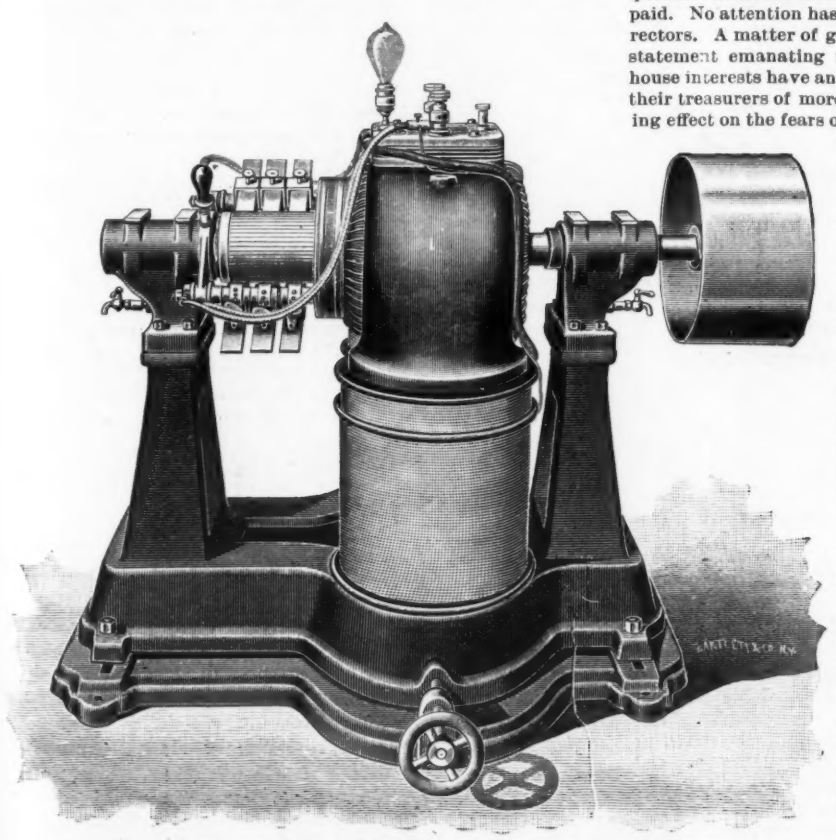
tinctive feature being the location of the steam cylinder or engine, which is secured adjacent to the well in a horizontal position on a suitable foundation, instead of being placed vertically over the well, as is the usual practice. This permits of the removal of the working barrel, bucket, pump rod, etc., without moving the steam cylinder or any part of same from its foundation; neither is it necessary to disconnect the steam or exhaust pipes to get at working parts in the well. The convenience and value of a pump for such service, constructed in this way, are apparent.

Another feature is the absence of buffer or spring beams, as used in connection with the vertical well pump, a uniform and steady piston movement being secured, however deep the well, by the manipulation and arrangement of steam valve.

The operation of the Davidson well pump will be understood when we say that the bucket in the working barrel, and the upper plunger, are actuated by the movements of the steam piston through a working-beam overhanging the well. Water is discharged by the bucket on the up stroke and by the plunger on the down stroke. The area of the horizontal section of plunger is one-half that of the bucket, insuring an even and steady delivery. The steam valve motion is adjustable from the outside for any depth of well, and can be adjusted while the engine is running.

La Roche New Direct Current Dynamo.

In our issue of June 10 we gave a description and illustration of the La Roche new alternating current dynamo, and illustrate in this issue their new direct current dynamo, both of which are manufactured by the La Roche Electric Works, of Philadelphia. We take advantage of this occasion to correct an annoying typographical error that crept in the description of the former machine, in which



LA ROCHE NEW DIRECT CURRENT DYNAMO.

one line was duplicated and another omitted; the statement affected was that the new alternators are built for a frequency of 16,000 alternations, or, more strictly speaking, 133 periods per second, and in sizes from 25 to 3,000 lights.

The new direct current machine is one of the most successful machines turned out of the well known La Roche works, and, as will be noticed, is of the motor type, with Gramme ring armature of the latest improved construction, thereby reducing the speed very materially. It has all modern improvements, with all parts interchangeable and made to gauge. The machine is compound wound and was designed by Mr. F. A. La Roche. It is so constructed as to stand the most severe abuse that any machine of this kind can be subjected to. It has self-oiling bearings and automatic oil overflow. The brush holders are of a new design, so made that any degree of tension can be secured, and so arranged that a free movement of the brushes around the commutator is allowed.

The commutator is made of specially hardened copper, well insulated with mica. It will be noticed that the winding of the machine is peculiar, as any of the coils, either series or shunt, can be removed and new ones put in place without interfering with any other part of the machine. An extra heavy steel shaft is used, thereby allowing no vibration and permitting the armature to run very close to the pole pieces, consequently increasing the efficiency of the machine.

At a test of one of these machines it is claimed that there was a variation of only 1.3 volts between no load and full load, which is a sufficiently close regulation for any purpose that a machine of this kind may be put to.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, June 24, 1893.

The electrical stock market during the past week has been utterly devoid of any news that might specially influence the quotations of this class of securities. The general stock market has been erratic in its course. One day bull sentiment has predominated to such an extent as to give all stocks an appearance of material strength that has been quickly dissipated on succeeding days when the announcement of news of an unfavorable character has acted even more strongly upon the market than the good tidings of previous days. This is easily understood when one considers the stock market's present condition. The absence of activity in any one quarter induces a susceptibility to unfavorable factors that, while not indicative of inherent weakness, is not conducive to helping quotations up easily.

General Electric closes this week lower than last Saturday. Its price at one time to-day was as low as 69¾, the highest price for the week being 73⅜, which was scored on Wednesday, an extreme fluctuation of nearly 4 points. The net loss for the week is ⅛ point. There were several attempts during the week to raid the stock on the assumption that the next dividend, soon to be declared, will be so reduced as to put the stock on a 4 per cent. basis. The failure of the bear crowd to force the price down was due to the strong support given the stock by the insiders. Nevertheless, the report about the reduced dividend still holds currency, though so far there has been nothing in the action of the directors or of the other officers to give any foundation to the story. Perfect satisfaction is felt by the management with the condition of business, and the financiering of the company is not, they say, meeting with any difficulties, all reports to the contrary notwithstanding.

Western Union was next in point of activity to General Electric. It is now selling ex-dividend, and the price, 82½, is the same as that at which it sold last Saturday "dividend on." The company has made a satisfactory agreement with the Board of Control regarding the sending of reports from the so-called legitimate "racetracks," and will, therefore, continue to reap the profits from this lucrative branch of its business. The officials, moreover, state that it is making up in other directions the losses entailed by the closing of the poolrooms in this city, to which the Western Union furnished exclusive service.

Westinghouse Electric Company's preferred stockholders up in Boston, or certain ones of them, are said to be beginning to question when the dividend, usually declared at this time, will be paid. No attention has as yet been given to the matter by the directors. A matter of great importance in this connection is the statement emanating from Pittsburg that three of the Westinghouse interests have an outstanding bank account to the credit of their treasurers of more than $1,100,000. This ought to have a calming effect on the fears of those people who doubt the ability of the Westinghouse companies to command cash. The preferred stock amounts to $4,000,000; the last dividend of 3½ per cent. was declared on Jan. 3 last. The stock is entitled to 7 per cent. cumulative dividends.

The American Bell Telephone Company has just issued a comparative statement of instruments in use on June 20 that makes a gratifying showing. On Dec. 20, 1892, there were in licensees' hands, under rental, as per last annual report, 552,720 instruments. Since then there have been added 24,415 instruments (the largest addition, 5,756, being made in May), so that the present total on June 20, 1893, was 577,135, against 535,921 instruments in use on June 20, 1892, a comparative increase of 41,214 telephones. This speaks sufficiently as to the prosperous condition of the company. Its stock now sells in Boston, where it is listed on the Exchange, for 190.

Two foreign telegraph companies declared dividends, elected officers and made statements this week. The directors of the Central and South American Telegraph Company declared the usual quarterly dividend of 1¾ per cent. payable July 1, and reported that the gross surplus for the quarter was $372,942. The directors of the Mexican Telegraph Company declared a quarterly dividend of 2½ per cent., payable July 8. The quarterly statement shows a surplus of $365,789. Mr. James A. Scrymser has been elected president of both companies.

Quarterly dividends of 2 per cent. each have been declared by the Edison Electric Company, of Philadelphia, and the Boston Electric Light Company. Bids of 104 are made in Boston for the stock of the latter company.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	25	30
Detroit Electrical Works	10	2	3
East River Electric Light	100	..	65
Electric Con. & Supply Co. pref.	15	15	16
" " " " com	15	15	17½
Edison Electric Ill., New York	100	106	106
" " " 1sts	...	106½	108
*Edison Electric Ill., Brooklyn	100	98	103
" " " Boston	100	115	130
" " " Chicago	100	220	230
" " " Philadelphia	100	120	140
Edison Electric Light of Europe	..	2	6
" Bonds	..	80	85
" Ore Milling	..	5	12
Fort Wayne Electric	..	12½	12¾
General Electric Company	100	70½	70¾
" " deb. 5's	..	84½	85
Interior Conduit and Ins. Co	100	30	40
Mount Morris Electric	..	..	65
Westinghouse Consolidated	50	24	25
" " pfd	50	45	47

* Ex. div.

AFFAIRS OF THE COMPANIES.

The Stanley Electric Company, Pittsfield, Mass., has voted to increase the capital stock from $190,000 to $200,000. The reason for this increase is that the business of the company is growing so rapidly that more capital is required to keep pace with the expansion. The new Stanley motor is proving a great success, and its manufacture is certain to develop a large business.

The Central & South American Railway Company has elected the following officers: James A. Scrymser, president; Edward D. Adams, vice-president; Sebastian Camacho, resident vice-president, City of Mexico; Samuel C. Blackwell, treasurer; Jas. W. Beard, secretary. The usual quarterly dividend of 1¾ per cent. was declared, payable July 1. The statement for the quarter shows the gross surplus of the company to be $372,942.

The Standard Electric Company, of Detroit, has elected the following directors: R. E. Turner, of St. Joseph, Mo.; O. H. P. Baxter, of Pueblo, Colo.; W. T. Anderson, R. H. Stockton and W. H. Little, of St. Louis, Mo.; M. J. Dee, S. W. Itsell, J. W. Frisbie and Thomas Fairbairn, of Detroit. Mr. Turner was subsequently elected president, Mr. Anderson vice-president and W. H. Little secretary and treasurer. Mr. R. H. Stockon, of St. Louis, was elected the fifth member of the Executive Board, the other four members being officers of the company. This company owns and manufactures the Logan storage battery. It already has orders for batteries sufficient to keep its factory in Detroit running at its full capacity for six months. W. H. Little will remove from St. Louis to Detroit to take charge of the company's offices.

NEW INCORPORATIONS.

The Fairmount Railway Company, Denver, Colo., capital stock $10,000, has been formed to build a railway. Wm. Teller, W. H. Bush, T. H Porter, R. H. McMann, and F. C. Young are interested.

The Garton-Daniels Electric Company, Keokuk, Ia., capital stock $20,000, has been formed to manufacture and sell mechanical appliances. J. C. Daniels and W. R. Garton are interested.

The Sloss-Stein Electric Company, Chicago, Ill., capital stock $50,000, has been formed to manufacture and sell electrical appliances. Sydney Stein, A. M. Sloss and Louis Stein are the promoters.

The Voorhees Electric Company, Boston, Mass., capital stock $5,000, has been formed to manufacture and sell electrical appliances. J. N. Ladensack, Geo. R. Blinn and G. T. Voorhees are the promoters.

The North Chicago Electric Railway Company, Chicago, Ill., capital stock $2,000,000, has been incorporated to construct railroads. C. H. Gurney, J. E. Burke and Alex. M. Savage are the promoters.

The Wagner Electro-Medical Company, Chicago, Ill., capital stock $50,000, has been formed to make and sell electrical supplies for physicians' use. C. B. Gregg, W. D. Hawk and J. S. Goodwin are interested.

The Columbian Electrical Company, St. Joseph, Mo., capital stock $2,000, has been incorporated to do a general electrical business. The promoters are G. S. Rough, C. H. Roehl and F. C. Barrington, all of St. Joseph, Mo.

The Independent Electric Company, Chicago, Ill., capital stock $25,000, has been formed to do a general electrical manufacturing and machine shop business. W. F. Hall, S. G. Hicks and N. D. Levin are the organizers.

The Maine Electrical Construction Company, Fairfield, Me., capital stock $10,000, has been formed to construct and equip electrical plants. C. H. Maxfield, F. E. Vickery, B. F. Maxwell and J. R. Donnelly are the promoters.

The Citizens' Electric Light Company of Wayne, Pa., capital stock $5,000, has been organized for light, heat and power purposes. The promoters are F. Weckerly, L. Dodson, Jr., St. Davids, and J. H. Jefferis, Wayne, Pa.

The Commercial Telegraph and Messenger Company, New York, N. Y., capital stock $5,000, has been organized to construct and maintain lines of telegraph. T. H. Price, S. T. Hubbard, J. A. David and A. President are the promoters.

The O. O. Electric Light Company, Saco, Me., capital stock $10,000, has been formed to manufacture and deal in electricity and gas for light, heat and power purposes. H. B. Bennett, J. W. Duff and W. J. C. Milliken are the promoters.

The Trenton Electric Construction Company, Trenton, N. J., capital stock $25,000, has been formed to manufacture and sell electrical apparatus. G. F. Applegate, J. P. Toman, C. F. Adam, Anton Adam and Paul Lupke are the organizers.

The Continental Gas Company, Chicago, Ill., has been incorporated with a capital stock of $10,000,000, to manufacture and deal in gas, electricity and appliances and plants for same. Chas. Springer, E. B. Stuart and C. S. Corning are the promoters.

The Easton & Bangor Electric Railway Company, Easton, Pa., capital stock $100,000, has been formed for the purpose indicated in the title. The incorporators are J. Marshall Young, D. W. Nevin, Easton, Pa., and G. G. Snyder, Mt. Pleasant, Pa.

The United States Electric Lamp Lighter Company, of Detroit, Mich., capital stock $50,000, has been formed to make and sell electric lamp lighters. The incorporators are as follows: J. C. Chambers, L. D. Godfrey and J. S. Johnston, Detroit, Mich.

The Richmond Light, Heat and Power Company, Richmond, Va., capital stock $300,000, has been formed to manufacture and sell electricity and electrical machinery, etc. J. D. Platt, J. E. Lowes, J. C. Reber and Archibald Stuart are the organizers.

The Cummings & Engleman Conduit Company, Detroit, Mich., capital stock $300,000, has been formed to make and sell conduits and to construct electric railway and power plants. J. F. Cummings, E. M. Engleman and J. H. Land are the incorporators.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, June 26, 1893.

The electric plant at the Natural History Museum is not working satisfactorily. During July and August the museum will be closed on Wednesday and Saturday evenings, in order that the necessary repairs and improvements may be made.

Dr. Cornelius Herz is reported to be dying at Bournemouth, Eng., where he has been for some months in very poor health. Dr. Herz is well known as the Director of *La Lumiere Electrique*, and the supporter of a number of important electrical enterprises. It is believed that his condition is hopeless, and that his death is only a question of a few hours or days.

Louis Nahm, Esq., secretary and treasurer of the American Electrical Manufacturing Company, of St. Louis, Mo., is in New York, making arrangements to establish an Eastern agency for the sale of that company's lamps. During a call at the offices of THE ELECTRICAL WORLD, Mr. Nahm stated that there was a brisk demand for their lamps.

ALBANY, June 24, 1893.

The Albany Railway Company has made application to the State Railroad Commissioners for their approval of the proposition to increase its capital stock from $1,250,000 to $1,500,000. The application has not been acted upon.

Ex-District Attorney Hamilton, of Saratoga county, will appear before the Railroad Commission on July 6 at the hearing on

the matter of the Saratoga electric road. It is alleged that the railway company did not receive the consent of a majority of the property owners along the street through which its line runs.

PITTSBURGH NOTES.

Pittsburgh, June 24, 1893.

The Allegheny County Light Company, of this city, has recently put up 40 additional arc lamps, and their plant operates now about 1,300 arc lamps, 4,500 incandescent lights and about 1,000 h. p. motors.

The Second Avenue Passenger Railway Company has about completed the extension of its main line from Glenwood to Braddock, a distance of four miles. The track is nearly all laid and the company expects to be running cars over the entire route, from the market-house, this city, to Braddock, a distance of nine miles. The cars are equipped with the Westinghouse single reduction motors.

The Westinghouse Electric and Manufacturing Company's workmen held their annual picnic last Saturday at Alequippa Grove, near this city, and the day was spent in the most delightful manner. About 3,000 men, with their wives, sweethearts and children, took part in the outing. It has been the custom of the company for years to give the shops a day off during the hot weather, and the employés have always made the most of it by holding a picnic.

The electric lighting companies of Pennsylvania have lately organized and formed the Electric Light Association of Pennsylvania. The object of the organization is mutual protection in such matters as taxation, franchises and legislation. The meeting took place at Harrisburg, and the following gentlemen were elected officers of the Association: R. E. Wright, of Allentown, president; G. H. Blater, of Pittsburgh, vice-president; Clarence H. Walle, secretary, and R. D. McGonigle, treasurer. The Association meets at the call of the Executive Committee, and the annual meeting is always held in December. Of the 100 companies in the State, 50 have already joined the organization and the rest are rapidly following.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, Mass., June 24, 1893.

Mr. Walter Chase, manager of the Mason Regulator Company, Boston, Mass., is at present visiting the World's Fair.

Boston Electric Company, Boston, Mass., manufacturer of the well known Boston burners, is enjoying a large sale for its excellent burnerss.

The American Magnetic Electric Company, Boston, Mass., is rapidly perfecting its different lines of magneto apparatus, and will be in the market shortly.

Mr. Charles E. Bibber, who has been sojourning at Chicago and its vicinity, can be found again at his Boston office, talking of the merits of motors, dynamos, arc lamps, and general supplies which he handles.

The "Poet" of the American Circular Loom Works, of Boston, Mass., who, by-the-bye, has just returned from a Western trip, and, if reports are true, has not forgotten the art of selling goods—tells us that Canvas Jacket wire is having a very extensive sale through the West, and that the Eastern trade is very satisfactory.

The Wilmot & Hobbs Manufacturing Company, Bridgeport, Conn., is probably without exception the largest gong manufacturer for electrical purposes in the United States; these gongs are carried in stock by all the leading electrical supply houses of the country. They are manufactured in sizes from one to six inches in diameter, and are finished with an A1 nickel.

The Pettingell-Andrews Company report the state of trade as being very satisfactory. Mr. D. A. Andrews, the vice-president and manager, who is known to the fraternity as a shrewd energetic worker, has contributed much, no doubt, to the present status of the business. The company has recently published its latest catalogue E W. which is fully illustrated, describing in detail and giving price lists of the various goods either manufactured or dealt in by this enterprising New England house.

WESTERN NOTES.

Cincinnati, O., June 24, 1893.

Houliston, Hubbard & Co., Cincinnati, O., have sold out to the Post Glover Electric Company. This firm were dealers in electric supplies and contractors for electric work.

Jacob May, formerly of Sebastian & May, Sidney, O., has severed his connection with that company and has become a partner in the Sebastian Lathe Company, Cincinnati, O., and will continue the manufacture of engine and speed lathes, tools and supplies. Mr. Benj. Sebastian, Jr., is fortunate in securing Mr. May as a partner, as both are experienced in the manufacture of these goods and will now extend their business considerably.

Thomas James Craighead, of the well known firm Craighead Engineering Company, Cincinnati, O, was married June 7 to Miss Elizabeth G. Bailey, of Covington, Ky. The handsome young bride is a favorite in society and belongs to a prominent and well known Quaker family that has been successful in business for years. The happy young couple started on a wedding tour through the East, stopping at White Sulphur Springs and Virginia Beach, Va.

Siemens & Halske, represented by T. C. Harnish, Cincinnati, O., has recently sold a plant to the Longview Insane Asylum, Carthage, O., consisting of two 50 kw. 85-h. p. dynamos, 2,000 lights, although their bid was considerably higher than several others. Mr. Harnish has secured to assist him W. P. Noble, of Portland, Ore., formerly district engineer for the Northwest for the General Electric Company, and will make Cincinnati headquarters now. Mr. Markle, having withdrawn, will give his attention to the electric light plant at Allegan, Mich., which he is interested in.

The La Boiteaux Electric Motor and Fan Company, Cincinnati, O., which manufactures the popular fan motors "Cyclone" and "Sea Breeze," that are oscillating and rotating when in operation, thus creating an equal current of air in all parts of the the room, reports a very busy season. It also manufactures the ordinary and revolving fan motors, and small motors for furnishing power for dentists, jewelers, printers, burnishers, window displays, etc. The factory has plenty to do filling orders from different sections of the country at this season. They have recently published an illustrated circular and price list.

The Nowotny Electric Company, Cincinnati, O, has fitted up its factory and office in better shape to make room for its extended business as manufacturers and dealers in electric light and treet railway supplies. It has also gone extensively into the buying and exchanging of second hand dynamos, motors and lamps, and now carries one of the largest and best assorted stocks of these goods of all makes and styles in the market. These machines are put in first class condition and good as new, it is claimed. This firm also does an extensive business in the repairing of all kinds of electrical apparatus, and is receiving and shipping to all parts of the country.

The Electrical Supply and Contracting Company, Cincinnati, O., although they are manufacturers, are making a specialty of repairing and rewinding armatures and refilling commutators for electric light and street railways, and keep in stock all sizes of motor and generator commutators. They use only the best tempered copper and clear white mica, accurately machined all over. Their arc lamps for incandescent circuits are the "Standard." They claim the "General" incandescent arc lamp, which they have the agency for, is giving perfect satisfaction, and can be used singly or from 2 to 12 in series on from 50 to 500 volt circuits. Another important branch of their business is buying and exchanging second-hand dynamos and motors, for which they have added considerable new machinery to their works and only employ experienced electrical mechanics. Mr. F. E. Perry, the president, has a thorough knowledge of this branch of the business, and as an electrical engineer and machinist is giving it his personal attention.

The General Electric Company, Cincinnati, O., although there is considerable stringency in the money market affecting business in general, finds that it has a large number of orders on hand, and more constantly coming in, keeping it very busy in all the different departments. It has recently made the following installations and sales: Warder, Bushnell & Glassner, of the Champion Mower and Reaper Company, of Springfield, O., one 125 h. p. generator, and a 50 volt motor and equipments complete; Dayton Malleable Iron Company, one 75-h. p. generator; King Powder Company, King's Mills, O., one 135-h. p. generator with motor and equipments for same; Cleveland Stone Company, North Amherst, O., 75-h. p. generator, motor equipments and drills; Hot Springs, Va., 50 light arc machine, 30-kw., 35 volt machine; Piqua & Troy Street Railway Company; Owensboro, Ky., Street Railway Company; Elwood Street Railway Company, Indiana; Cuyahoga Falls & Akron Street Railway Company; Kentucky & Indiana Bridge Street Railway Company; New Albany & Louisville, formerly called "The Daisy Line" and a large central station for light and power at Louisville, Ky., and a new station for electric light and power at Dayton, O.

Oregon City, Ore., June 19, 1893.

The Port Townsend (Wash.) Gas Works have been placed in the hands of a receiver, James R. Mason.

Citizens of Shelton, Wash., and Olympia are talking of constructing an electric railway to connect the two towns.

Geo. H. Tuxbury, of Adrian, Mich., has been in Oregon several weeks showing an Edison phonograph. He will make the Alaska tour and expects to exhibit the first phonograph in that territory.

The Electrical Reduction Company, composed of Tacoma and Chicago mining men, is making tests preparatory to installing a complete plant for reducing ores by impact and electricity in

The West Side Electric Railway line of the Portland General Electric Company is ready for the tracklayers. The rails are on hand. The Oregon City station and train sheds are about completed.

The East Side Railway Company has inaugurated a half-hourly service between Portland and Oregon City on Sundays. The delay in the completion of the new cars has prevented the further extension of the service, but it will soon be commenced.

The Portland & Vancouver Railway Company's double track electric line has been completed on Union avenue from East Couch to East Pine street. All of the poles are planted, most of the overhead line is up and the equipment of the road will soon be completed.

Frank T. Carroll, manager of the West Coast Phonograph Company, is now located at 152 First street, Portland, Ore. His company is subordinate to the Pacific Phonograph Company, of San Francisco, which holds the general agency for the phonograph west of the Rockies.

J. H. Cummings, a former superintendent of the Tacoma Railway & Motor Company has, it is reported, settled his claim against the road for salary as constructing engineer for $19,000. It has been rumored that, with the assistance of Chicago capitalists, he will construct a competing street railway system in Tacoma.

The Portland General Electric Company has placed in operation, at the site of its new water power station in Oregon City, a rock crusher having a capacity of 40 tons an hour, which, in connection with a mixer of equal capacity, is being used in preparing materials for the walls of the headworks and canal leading to the station.

The Portland General Electric Company has received the first shipment of machinery for its new water-power electric station in Oregon City, including a Victor horizontal turbine wheel. A platform has been constructed on the bank of the Willamette River, adjoining the foundations of the station, for the temporary storage of the 190 carloads of machinery which are expected to arrive before the completion of the building.

The Rainier Power and Railway Company, and the Seattle Consolidated Street Railway Company, of Seattle, in which D. T. Denny is the principal stockholder, were recently placed in the hands of Receiver Jacob Furth. It is reported that the failure to dispose of bonds caused the unexpected event. Mr. Denny, who is one of the largest real estate owners in Seattle, has given trust deeds and deeds and mortgages to his property for the protection of his creditors He organized the Rainier Power and Railway Company several years ago, and built an electric line to Lake Union. Last year his company constructed the Third street line, extending from the business centre to a connection with Lake Washington. This year he also acquired control of the Seattle Consolidated Company's system and operated both lines under one management.

ENGLISH NOTES.

(From Our Own Correspondent.)

London, May 31, 1893.

Automatic Railway Signaling.—As I dare say your readers are aware, there is a considerable—and what we consider to be a natural aversion—in this country to automatic railway signalling. As I wrote to you at the time of the opening the Liverpool Overhead Electric Railway Company has, however, laid down a complete system of electric automatic signaling. Up to the present these signals have not been worked automatically, owing to the Board of Trade's consent having been withheld. This has now been obtained, and for the first time in the history of English railways the signaling of a line will be carried out automatically from one end to the other.

A Round-About System of Electrical Distribution.—Many of your readers are no doubt aware of the system which has for many years past been used by the electric lighting company in Paris, which was until recently under the auspices of M. Victor Popp. The system is now to be thoroughly reorganized before the coming winter, but the concern seems still unable to indulge in plain, straightforward methods. The new idea is to place three 1,100-volt Thury dynamos in series at a central station, for the purpose of supplying current to 21 Thury continuous current transformers, which will in turn supply current to batteries of accumulators in as many substations, and it is from the batteries finally that the lamps will receive their current.

Telephones and Electric Traction.—At the last meeting of the Electrical Trade Section of the London Chamber of Commerce it was decided to appoint a special committee with power to raise funds, to engage counsel and to take such steps as may be necessary for the protection of electric traction interests at the forthcoming Parliamentary inquiry into the question as to whether the telephone company or the electric traction companies are to be obliged to work with complete metallic circuits. The general manager of the National Telephone Company, who was present at this meeting, naturally offered a vigorous opposition to the proposal, an opposition which was somewhat nullified when he was assured that no attempt would be made to obtain for the proceedings of this special committee the weight and support of the London Chamber of Commerce itself.

Municipal Lighting.—The Bradford corporation is unable to decide whether to substitute the three or five wire system for its present two-wire network, and has called in Lord Kelvin to assist it in making up its corporate mind. The municipal station at Burnley is expected to come into operation within the next two or three months. Sunderland and Southport are both engaged in considering electric lighting schemes prepared by experts. The town of Hanley in Staffordshire has been recommended by its borough surveyor to make use of incandescent lamps for street lighting, and he estimates that they will cost considerably less than gas. It is to be regretted that this sort of estimate should be made. When it was recently proposed to light the alleys and side streets of the City of London by incandescent lamps, the idea was aptly compared to watering the streets with rose water.

GERMAN NOTE.

(From Our Special Correspondent.)

Berlin, June 10, 1893.

The Projected Electric Elevated Railway for Berlin.—This much discussed and interesting scheme has at length successfully combatted the difficulties, real or hypothetical, with which it has been beset since its inception, and appears now to be on the high road toward realization. It may be remembered that the scheme was vigorously opposed by the authorities of the Luther Church on the ground that the line, as proposed, would run in such close proximity to the sacred edifice as to constitute a serious nuisance, and the matter was deemed of such urgency that it was made the subject of special representations to the Emperor. Recognizing, however, the broad principle of the subordination of the individual to the common interest, the Emperor dismissed the petition, a result which has been received with general satisfaction. This removes the last obstacle in the way of the project, and the concession may now be confidently expected. Messrs. Siemens & Halske have as yet received no official intimation on the subject, but they have it from a reliable private source that the Emperor has *de facto* given his sanction to the work. An indication of the route which it was proposed the line should take has already been given in The Electrical World, and this route has, with some slight modifications, been preserved in the approved plans. The work is to be carried out within a period of two years.

News of the Week.

ELECTRIC LIGHT AND POWER.

Alameda, Cal., will grant a franchise for electric lighting.

Lake Mills, Wis., has granted an electric light franchise to F. B. Fargo.

Bradford, Pa.—Councilman Terrill will give details of a proposed municipal electric lighting plant.

Chehalis, Wash., proposes to purchase an electric plant to run the town lights, now supplied by contract.

Rome, N. Y.—Mayor Gillett and another prominent citizen are agitating in favor of municipal electric lighting.

Reading, Pa.—Chas. Greth and Wm. Hendricks, of Reading, will establish an electric plating works at Lebanon, Pa.

Whitestone, L. I., N. Y.—The trustees of Whitestone are contemplating the purchase of an electric lighting plant.

Dowagiac, Mich.—Dowagiac at a special election decided to buy the electric light plant now owned by a corporation.

Austin, Ill.—At the meeting of the Board of Trustees of the town of Cicero $18,000 was appropriated for electric lighting.

Niagara Falls, N. Y.—The Buffalo & Niagara Falls Electric Light and Power Company has received the contract for street lighting.

The Royal Electric Company, of Montreal, proposes to dam the Richelieu River at Champlain Rapids for electric power purposes.

Hagerstown, Md.—The Schuyler Electric Company, of Middletown, Conn., has been awarded the contract for city lighting for five years.

Youngstown, O.—The several lighting companies of Youngstown have combined under the name of the Youngstown Light and Power Company.

Sea Cliff, L. I., N. Y.—A franchise was granted to an electric lighting company in April, but no action has yet been taken toward putting in a plant.

Kenosha, Wis.—Dr. Hazelton and other local capitalists are contemplating the purchase of the electric lighting plant from W. S. Reed & Company.

Galena, Ill.—The Galena Electric Light Company will transfer its plant to Baraboo, Wis., owing to failure to get the contract for street lighting here.

Berkley, Va.—The Berkley & South Norfolk Water and Electric Light Company have petitioned the Council for authority to put in and operate an electric lighting plant.

Saco, Me.—The O. O. Electric Light Company has been organized to carry on a general electric business. John B. Duff, of Old Orchard, is president, and Henry B. Bennett, of Portland, Me., is Treasurer.

McKeesport, Pa.—Mr. Stratton, of the City Property Committee, states that the city will soon purchase ground on which

will be built both a garbage furnace and an electric lighting plant. Chairman Allman will give details.

Binghamton, N. Y.—The central station has purchased two Shapley & Wells boilers, two 250-h. p. Ball compound engines, one McIntosh & Seymour 350-h. p. compound engine and two Armington and Sims 250-h. p. engines.

New York, N. Y.—The Park Board advertises for bids for furnishing a subsidiary electric lighting plant for the north wing of the Metropolitan Museum of Art. The office of the Department of Public Works is 51 Chambers street, New York.

Topeka, Kan.—The State Board of Public Works advertised for bids for the new assembly room and electric light plant at the Olathe deaf and dumb asylum and the contract will be let on July 3. The amount appropriated by the Legislature is $18,000.

Peabody, Mass.—A committee has been appointed in the matter of the proposed electric lighting plant for the town, and they have been empowered to contract for the work. P. L. Winchester, Andrew N. Jacobs and J. Arthur Trask are the committee.

Iron Mountain, Mich.—A. A. Fonrman, superintendent of the electric light plant at Iron Mountain, Mich., has made a proposition to the people of Norway that if they will agree to take 350 to 500 lights he will string the main wire of his plant to that city.

The Bristol (Conn.) Electric Light Company will begin at once on extensive improvements to its plant. An addition 30 or 40 feet long will be built, and a new boiler, engine and dynamo will be procured. This action is made necessary by the increased demand for lights.

Elizabeth, N. J.—The Suburban electric plant was burned on the night of Monday, June 19. By an effort which has received much praise Superintendent McGiffert has succeeded in erecting a temporary plant, and on Wednesday night the arc-light system was in full operation. The work of rebuilding the burned plant will begin at once.

Augusta, Me.—The joint committee of the city government has received two bids for street lighting for the year 1894 and thereafter—one from Bangs & Co., and one from the Kennebec Light and Heat Company—but neither was satisfactory, and the committee now state that they will secure estimates for the construction of an electric light station, to be run by steam and to be owned and operated by the city.

The Central Power Company, of Newark, N. J., has secured control of the Schuyler Electric Power Company and the United Electric Traction Company, both of Newark. The impression prevails that the Newark Electric Light and Power Company will next be absorbed, and that the whole will pass into the control of the Consolidated Traction Company. The transfer of the Schuyler company includes plants in Marion and other places in New York, New Jersey and Pennsylvania, valued in all at $700,000.

THE ELECTRIC RAILWAY.

South Peoria, Ill., has granted a franchise for an electric railway.

Lockport, N. Y., is to be connected with the Buffalo & Williamsville electric railway.

The Shenandoah (Pa.) Council has granted a street railway franchise to Councilman J. F. Finney and others.

The Frankford & Southwark (Pa.) road will be operated by electric power by the Electric Traction Company.

Syracuse, N. Y.—The Syracuse, Eastwood Heights & Dewitt Railroad will rebuild its power house, recently burned, on ground not yet chosen.

East St. Louis, Ill.—The East St. Louis Electric Street Railway Company has certified to the increase of its capital stock from $150,000 to $500,000.

Holyoke, Mass.—The Holyoke Street Railway Company is making arrangements for building a new power house to be completed by October 1.

Westerly, R. I.—The Westerly & Jewett City Railroad have been granted a charter, and it is likely that steps will at once be taken to build the road.

The Passaic Elevated Transit Company has mortgaged its property for $2,000,000 for the construction of a double track electric line from Jersey City to Newark.

Uhrichsville, O.—The Council has accepted the bid of C. E. Mitchener for the proposed electric railway from here to New Philadelphia and work will begin at once.

Mount Vernon, N. Y.—The North Mount Vernon Electric Railroad Company will operate an electric street railway here by the storage battery system. Some of the cars have already arrived.

Salem, Va.—The City Council of Salem has granted the franchise asked for by the Roanoke Street Railway Company, which proposes to extend its lines up Alabama street to a point on Main street in Salem.

Newark, N. J.—The Franklin Township Committee has granted permission to the Newark & Paterson Electric Railway Company to lay tracks through the township. It is claimed that the road will be running by Sept. 1.

Manitou, Colo.—Franchises have been granted to Hon. M. A. Ledd, to construct an electric railway on Manitou and Ruxton avenues. Work on the road will commence Sept. 1. The cost of building the line will amount to $50,000.

Chester, Pa.—Major J. R. T. Coates, president of the People's Railway, has gone over the proposed route of the line in company with the engineering corps, and as soon as right of way through the city of Chester can be got work will be commenced.

Elizabeth, N. J.—The City Council has refused to grant a franchise to the Plainfield & Elizabeth Electric Railway unless it pays five per cent. tax on one-third of its gross receipts, which the company has refused to do, and it has withdrawn the application for the franchise.

White Plains, N. Y.—On July 7 the Board of Trustees of White Plains will hear the application of the New York, Elmsford & White Plains R. R. Co., of which W. Preston Hix is president, and of the New York, White Plains & Mamaroneck Railroad for right of way for trolley system roads.

Brooklyn, N. Y.—The mayor has signed the street railway franchise granted on June 19 to the Brooklyn City, Nassau Electric, and Kings County Electric Railroad companies. The various companies are to pay 1 per cent. on $20,000 per mile of gross receipts 2 per cent. on $30,000, and 3 per cent. on $40,000 or more. The propositions of the Union Street Railway Company to pay a tax on gross receipts and from $12,000 to $20,000 at once in addition per mile were rejected.

The New Jersey Traction Monopoly.—The New York *Herald* devotes almost a page in its issue of June 25 reviewing the numerous acquisitions of franchises recently made by the Consolidated Traction Company in the cities of Newark and Jersey City, and in the surrounding towns and country, and intimates there is a connection between it and the other companies operating in the State. The company is said to control $100,000,000, and has already secured the car lines in Newark, Jersey City and Elizabeth; it is now said to be negotiating for those of Brunswick and Trenton, and will finally connect with the system advancing from Camden. It is intimated that the Pennsylvania Railroad has some connection with the syndicate as well as politicians in the various places where franchises have been secured.

LEGAL NOTE.

The appeal in the case of the Pittsburgh Reduction Company against the Cowles Electric Smelting and Aluminium Company, of Cleveland, O., pending at Detroit, before the United States Circuit Court of Appeals, has been dismissed on the motion of the appellants the Cowles company, at their cost The patent at issue was the Hall patent, which covers the commercial method at present used for manufacturing aluminium. This patent had been adjudicated and entertained by the United States Circuit Court for the Northern District of Ohio, and the result of the decision leaves the Pittsburgh company the only manufacturers of aluminium in the United States.

PERSONAL NOTES.

Mr. William H. Knight, of Pasadena, Cal., recently contributed a popular article on electric power to the Pasadena *Star*.

Mr. E. D. Libbey has been appointed glass cutter to Her Royal Highness the Princess Donna Infanta Eulalie, and will make her a glass dress.

Mr. Alexander Dow has been appointed city electrical engineer of Detroit, Mich., with a salary of $3,000 a year. Mr. Dow is said to have served in every capacity from trimmer to manager in the electric light business. He is a member of the Electrical Club of Chicago. He constructed the electrical plant in Washington Park, Chicago, and is especially familiar with underground work.

MISCELLANEOUS NOTES.

The General Electric Company's draughtsmen at Lynn, Mass., have returned thanks to Mr. E. W. Rice, Jr., for reducing their working hours from 52 hours per week to 50, without reduction of pay.

Electric Vehicle.—Mr. E. D. Chaplin, of Boston, has built an electric wagon which he has used in the streets of Boston, and is at work on another that will weigh only 800 pounds and run at a speed of 10 miles per hour.

The Case School of Applied Science, Cleveland, O., has issued a pamphlet containing views and brief descriptions of its new laboratories. It is apparent that the equipment of this institution in this direction is most excellent.

Boulder, Colo.—The Regents of the University have decided to begin the construction of a mechanical and engineering building. In it will be placed the heating apparatus, also engines and dynamos, so that in the future the buildings on the campus will be lighted by the university's plant. Horace M. Hale is president.

Easton, Pa.—Sealed proposals for furnishing the fire department with about six miles of hard-drawn insulated wire to be used for the Gamewell fire alarm system, will be received to 5 p. m. July 17, by L. M. Fine, city clerk. Samples of wire wanted will be furnished on application to Thos. P. Ricker, chief of the fire department.

The Manchester (N. H.) Electric Club has elected the following officers: President, J. B. Smith; vice-president, C. J. Abbott; treasurer, E. J. Burnham; secretary, T. E. Morse; Executive Committee, J. B. Smith, W. K. Robbins, W. H. Fairchild and E. M. Bryant. At the last meeting W. H. Robbins read a paper on "Scientific Methods."

Electricians' Examinations.—It is proposed by certain city officials of Cincinnati, O., to organize a board, to consist of the city electrician and two other officials, to examine electricians and give certificates of competency, such as are required of stationary engineers. It is proposed to have six degrees of certificates—dynamo tender, first and second class outside and inside wiremen and inside helper.

The University of Minnesota has issued its annual catalogue for 1893. This institution has built up a very creditable course in electrical engineering, which is in charge of Prof. Geo. D. Shepardson. The laboratories are well equipped with testing instruments, dynamos and motors, and all the apparatus necessary for the practical work which is now regarded as so essential in the education of the electrical engineer.

An International Maritime Congress is to be held in London, England, July 21, and among the papers to be read are the following on electric l subjects: "Methods and Formulas for Calculating the Illuminating Power of Lighthouse Lamps," by M. Bourdelles; "Efficiency of Recent Gigantic Apparatuses Compared with Electric Light," by Domenico Le Gat o; "Investigations Made in the French Lighthouse Service on Electrical Machines with Continuous and Alternating Currents," by A. Blondel.

R. T. McDonald, of the Fort Wayne company, was mentioned in a recent suit brought by A. J. Cooper against the State Trust Company, of New York. The former secured a loan from the trust company of $125,000, $25,000 of which was paid to Mr. McDonald; it was claimed by Cooper that this payment was a mere subterfuge on the part of the trust company to get interest from him at the rate of 60 per cent. The defendants claimed that the amount paid Mr. McDonald was given to him by Cooper for services rendered and the court accepted this view.

The Johns Hopkins University has issued its annual register. The department of Electrical Engineering, which is one of the best in the country, is adding to its already fine equipment yearly. The course includes lectures on theoretical and applied electricity, steam and hydraulic engineering, central station equipment, machine design, mechanics of engineering, and practice in mechanical drawing. An important feature is laboratory work, to which much attention is paid, and original investigation is especially encouraged. The instruction is given by Dr. Louis Duncan, Associate Professor of Electricity; Mr. Hermann S. Hering, M. E., Associate in Electrical Engineering, and Mr. Francis Head, M. E., Instructor in Mechanical Engineering. The course extends through two years and is primarily intended for graduates, but special students are admitted on certain conditions.

Trade and Industrial Notes.

Messrs. Wm. C. Callman & Co., 136 Liberty street, New York, have been appointed sole agents for the sale of the "Phœnix" lamp in New York, New Jersey and the New England States.

The W. S. Hill Electric Company, of 133 Oliver street Boston, Mass., has published a neatly gotten up 56-page pamphlet devoted to the well known switchboard specialties of this firm. Switches for every purpose are illustrated, as well at a long line of switchboard fittings and rheostats.

The Atlantic battery fan motor 1893 proves to be a real success in filling the long felt wants for a well constructed, highly efficient battery fan motor. The Electric Chemical and Specialty Company, 130 Liberty street, New York, reports a lively business with orders coming in from all over the States.

The Sperry Electric Railway Company, of Cleveland, O., has issued a neat pamphlet describing and illustrating in detail their street railway system. Thirteen pages are devoted to tables and data that will be found of great use by electrical engineers, and particularly by those connected with traction work.

Messrs. Abendroth & Root Manufacturing Company, 28 Cliff street, New York, note a lively demand for Root's patent spiral riveted water pipe from foreign countries. It has just shipped a large supply of this pipe to South Africa. The trade of the company in this article abroad has grown to large proportions.

The Carpenter Enamel Rheostat Company, of Bridgeport, Conn., has issued a new catalogue of the extensive line of rheostats made by it, which will be found of interest by all electrical people. The various rheostats, dimmers, equalizers and arc resistances manufactured by them are illustrated and the full data relating to each are given.

The Fitch Battery and Electric Company, Oneida, N. Y., has sold its stock, trade and good will to the Galvano Faradic Manufacturing Company, 300 Fourth avenue, New York, which will hereafter be the sole licensee and manufacturer of the Perfect battery and excitant under D. H. Fitch's patent, and this old and known firm will hereafter fill all orders.

The B. F. Sturtevant Company, Boston, Mass., has printed a third edition of 10,000 copies of its 200-page general catalogue No. 61, which describes the uses of blowers, exhausters, engines, forges and heating and ventilating apparatus, and it desires to place a copy in the office of every superintendent, purchasing agent, engineer or manufacturer using such machinery.

The Jenney Electric Motor Company, of Indianapolis, Ind., has issued a neat 48 page pamphlet containing a partial list of users of their apparatus and a collection of flattering testimonials. Many of the latter have the weight of the names of prominent firms throughout the country who are not chary of their praise of the excellent motors manufactured by this company.

The Burgess Soldering Furnace Company, of Columbus, O., has added an improvement to the "regulating valves" of its Gem furnaces called the stock on the spindle. The accompanying illustration will give a good idea of this mechanism, and render any extended description unnecessary. In the future the Gem furnaces Nos. 3, 4, 5 and 6 will be equipped with this apparatus.

M. T. Davidson, Brooklyn, N. Y., manufacturer of the Davidson artesian well pumps, has recently placed several of these pumps in prominent establishments, among which is one 7-inch diameter steam cylinder × 18-inch stroke in Polar Construction Company's ice plant at Newark, N. J., and another of the same size in Halcyon Hall, Millbrook, N. Y., all of which are giving very satisfactory service.

The Ansonia Electric Company, of Chicago, has just issued a very neat and handy edition of its house goods catalogue which will be known as No. 44 B. It does not claim to have exerted itself very much in getting out this catalogue, as its mission is only temporary, but at the same time it contains quite a few new goods and some changes in prices which make the catalogue quite valuable. The company is at work on a large and complete edition, which will not be issued for several months.

The Viaduct Manufacturing Company, Baltimore, Md., has appointed Mr. Edward Lasell its Western agent, who is located at 225 Dearborn street, Chicago. Mr. Lasell is well known to the trade, and will attend to all matters in his territory relating to all quotations and sales of the Viaduct company's manufactures. With such specialties as the standard magneto bells, telephone switchboards, District Telegraph call boxes, fire alarm boxes, etc., of this company, Mr. Lasell will undoubtedly receive much business.

The Goulds Manufacturing Company, Seneca Falls, N. Y., has installed a large number of its well known pumps recently, including the following: One light service tank pump for supplying factory with water, Ashley & Bailey, Paterson, N. J; one triplex stuff pump, Jackson Paper Company, Jackson, Mich.; two triplex stuff pumps to the Solvay Process Company, of Syracuse, N. Y., and many others. Among the companies ordering is the S. D. Warren & Co., which has just placed an order for its sixth triplex stuff pump.

The Page Belting Company, of Manchester, N. H., has forwarded us a copy of the handsome souvenir it has issued to commemorate the twenty-fifth anniversary of the founding of its business. This neat brochure will be of interest to every belt dealer and user, giving, as it does, the various processes used in the manufacture of belting. The immense growth in the business of this great firm is well illustrated by the views of the first building used 25 years ago, in which one room 40 feet square was occupied, and the present works, in which 175,000 square feet of floor space are utilized.

"Queen" Apparatus at the World's Fair.—The Standard electrical instruments exhibited by this company are attracting increased attention each day, and prove of considerable interest to all who appreciate strictly high-class workmanship. The Armour Institute of Chicago is equipping an electrical laboratory in good style, and has already reserved some $3,000 worth of the instruments exhibited by Queen & Co. These are to be delivered in November after the Exposition has closed. The manufacturers consider this as a happy compliment to their product, as Mr. Armour spares no money in making his equipment the best in the country.

The Electric Appliance Company, of Chicago, promises some marked improvements in its well known Elkhart transformers in the way of a new fusing arrangement particularly adapted for circuit of 200 volts primary, and also in a system of removable coils, making it a very simple matter to repair an occasional burnout. The sales of the Elkhart converter for the past year, since the Electric Appliance Company took hold of it as general western agents, have been almost phenomenal, it is claimed, and it is now in use in nearly every part of the country. The improvements above mentioned have added materially to its merits, and a very heavy sale for the coming fall and winter is expected.

Messrs. L. J. Wing & Co., 126 Liberty street, New York, manufacturers of Wing's disc fans, gas engines, motors and dynamos, and contractors for heating, refrigerating, electric lighting and other apparatus, have recently made a large number of sales, a few of which are the following: Wright Universal Electric Company, *Courier des Etats-Unis*, Blackmore Heating Company, Peter Claus & Co., Moore Electric Manufacturing Company, Mount Morris Electric Company, American Lithographing Company, all of New York City; Fritz Humderhagen and F. Triacca, Machinery

Hall, World's Fair Grounds, Chicago, Ill.; and Diehl & Co., of Elizabethport, N. J., and many others.

The Mather Electric Company reports business very brisk at its New York office, 95 Nassau street. It has recently added to its force the following gentlemen: H. M. Stiles, formerly with the Thomson-Houston Company, has accepted the position of electrical engineer; H. W. Colby, formerly with the General Electric Company, of Boston, has taken the position of general agent for the sale of power apparatus and lighting plants. A. E. Bowers has entered the service of Claflin & Kimball, who are sales agents for the new "Novak" lamp, and will in the future look after this branch of the business. The Mather Company recently closed a contract with the Lynchburg Electric Company, of Lynchburg, Va., for one 100-h. p. generator and several contracts for small motors.

The United Electric Improvement Company, of Philadelphia, Pa., is progressing very rapidly with the work on its new factory building now in course of construction in Germantown Junction, Pa. This building will be of the most modern design and especially constructed for the manufacture of the improved Heisler Electric Company's electric light apparatus, which are at present being manufactured at Gloucester, N. J. The tools and machinery for this new building will be of the latest and most improved designs, the order for which has just been given. This company has recently booked several nice orders and has all it can do to supply the increasing demand. Mr. Walter F. Smith, the general manager of the company, superintends the work at the factory and also attends to his important office duties; hence he is a very busy man, but never too busy to greet his friends when calling upon him.

The Narragansett Electric Lighting Company, whose station at Providence, R. I., has frequently been referred to as the model plant of New England, is making additions which will largely increase its facilities. It has just placed an order with the National Water Tube Boiler Company, at New Brunswick, N. J., for a battery of 500 nominal h. p. of boilers, with an actual capacity of over 750 h. p. The National Company supplied the first boilers for this plant, the working pressure, which was then considered high, having been set for 140 lbs. per square inch. The advance in steam engineering practice has in the meantime been so marked that a boiler pressure largely exceeding any then used is now demanded. The National Company has been steadily improving the quality and methods of construction of its boilers, and those which they have supplied the Narragansett Company will be adapted for a working pressure of 200 lbs., with a large margin of safety.

W. R Fleming & Company, New York and Boston, report that they have closed during the past month the following contracts: Two 100-h. p. Ideal engines for electric light service in the municipal buildings at Ward's Island; two 60-h. p. and one 15-h. p. Ideal engine for the *Mail and Express* Building, New York City (third order); one 125-h. p. tandem compound Ideal engine for direct connection to dynamos for the Bridgeport Copper Company, Bridgeport, Conn.; one 50-h. p. Ideal engine and complete steam plant for electric light service for the Martha's Vineyard Company, Martha's Vineyard, Mass. This firm is now erecting the following engines, some of which have been completed and started during the past week: Two 500-h. p. tandem compound Ideal railway engines for the Montreal Street Railway Company, Montreal, Can.; two 500-h. p. tandem compound Ideal railway engines for the New Britain Street Railway Company, New Britain, Conn.; one 500-h. p. tandem compound Ideal engine for the Taunton Electric Light Company, Taunton, Mass.; two 75-h. p. Ideal engines for the Fiftieth street station and two 125-h. p. Ideal engines for the Houston street station of the Broadway and Seventh Avenue Railway Company, New York City; two 60-h. p. Ideal engines for the Stewart Building, New York City; two 50-h. p. Ideal engines for the Hotel Beresford, New York City; two 200-h. p. Ideal engines for the Central Park Apartments, New York City.

The Pierce & Miller Engineering Company, 42 Cortlandt street, New York, reports the following orders for the McIntosh & Seymour engines now under construction: Three 1,000-h. p. slow-speed 36-in. stroke, for the Brooklyn City Railway Company's new station at Ridgewood, Long Island; 1,000 h. p. plant for the City & Suburban Railway Company, Baltimore, Md.; 250-h. p. increase, making total of 1,000-h. p. plant, for the Central Railway Company, Baltimore, Md.; 800-h. p. electric lighting plant, Gravesend, Long Island; two 400-h. p. triple expansion vertical engines for the Citizens Electric Light Company, Brooklyn, N.Y.; 500-h. p. increase, making total of 1,000-h. p. plant, for the Newark Electric Light and Power Company, Newark, N. J.; 500-h. p. plant for the Sandusky, Milan & Huron Street Railway Company, Sandusky, O.; 400-h. p. plant for the Taunton Street Railway Company, Taunton, Mass.; 500 h. p. plant for the Mobile Street Railway Company, Mobile, Ala.; 300-h. p. plant for the Logansport Street Railway Company, Logansport, Ind.; 250-h. p. electric light plant for the Hotel de Logerot, New York City; several small orders amounting to over 1,000 h. p. are also in the course of construction. Messrs. Pierce & Miller were awarded the contract for the complete construction of the plant for Haskins' Wood Vulcanizing Company, Alexandria, Va., and also the order for the erection of the buildings, plant, dock and entire mechanical work for the U. S. Mortar Supply Company of New Jersey.

Business Notices.

Transformers rewound and repaired. Write for prices. The Hill Manufacturing Company, Salem, Va.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Where to Locate New Factories.—The Illinois Central Railroad Company is desirous of calling the attention of capitalists and manufacturers to the advantages possessed by the different cities and towns on their Southern lines and on the lines of the Yazoo & Mississippi Valley Railroad Company in the shape of unlimited raw material, proximity to markets, cheap labor, fuel, etc., and believes that it needs but a presentation of their merits to attract the careful attention of all interested in converting the raw materials to be found on their lines into the finished product. Prominent among these are cotton, hard and soft wood, clay, fruits, vegetables, etc. A descriptive pamphlet of 150 pages, entitled "Where to Locate New Factories," has been issued by the company, and a copy will be sent free on application to the undersigned, who will also give any further information as to inducements offered by the different localities for desired industries. Individuals or companies wishing to embark capital in cotton, clay, woodworking, canning or other industries can find a profitable field and hearty co-operation. For particulars address Geo. C. Power, Industrial Commissioner I. C. R. R., 58 Michigan Avenue, Chicago.

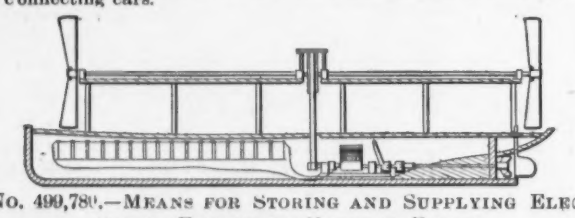
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

UNITED STATES PATENTS ISSUED JUNE 20, 1893.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

499,737. Secondary Electric Clock; R. S. Howland, Providence, R. I. Application filed Jan. 4, 1893. This apparatus comprises as its motive power a pendulum having an electro-attractive mass or armature and an electromagnet at one side of the centre of oscillation of the pendulum and within the attractive distance of the armature when the pendulum approaches the magnet in its vibration, in combination with a normally closed electric circuit, including a source of electric energy and said electromagnet, and a primary or master clock having a circuit controller which breaks the circuit at the completion of each unit of time, but which again closes the circuit before the pendulum completes its vibration.

499,748. Telephone Exchange; A. E. McClaren, Joplin, Mo. Application filed June 13, 1892. A central exchange receiving the line wires, automatically controlled connecting cars traveling over the line wires at the exchange, and transmitting devices connected with the line wires and adapted to control the connecting cars.



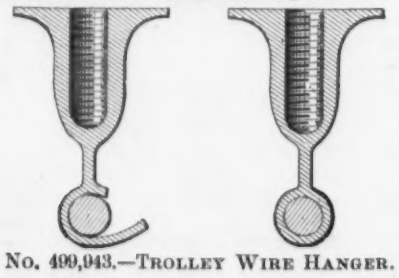
NO. 499,780.—MEANS FOR STORING AND SUPPLYING ELECTRICAL ENERGY BY NATURAL FORCE.

499,769. Regulator for Electric Motors; G. H. Whittingham, Baltimore, Md. Application filed March 24, 1892. The combination of a solenoid of low resistance, a conductor of high resistance connected to one of the terminals of the solenoid, a short-circuiting device for short-circuiting the conductor of high resistance, an iron core reciprocating within the solenoid, an iron cap located on the top of the solenoid, and means connected with the short-circuiting device of the high resistance conductor which is operated by the reciprocating core to break the short circuit and throw the conductor of high resistance into circuit.

499,770. Desk Switch; David J. Willis, New York. Application filed Nov. 30, 1893. This is composed of a spring controlled lever, the spring in combination with a contact point, a trunnion post, a bolt, metal strip, binding post and base.

499,780. Means for Storing and Supplying Electrical Energy by Natural Force; F. G. Corning, New York. Application filed Nov. 14, 1892. The combination of a boat, a propeller, a storage battery on the boat, a dynamo motor machine on the boat, a wind motor for operating the dynamo motor to charge the battery, and a shaft between the dynamo motor and propeller having a clutch mechanism. (See illustration.)

499,805. Electric Railway Grade Crossing; Haverstraw, N. Y. Application filed Aug. 26, 1892. The combination with the intersecting tracks of signals controlling the approaches to the crossing, the signals being normally at danger, electric circuits for the signals, time registers in the circuits, devices in the circuits for preventing the signals of intersecting tracks from being set at safety simultaneously, and means whereby a train approaching the crossing sets signals on its own track at safety, provided there are no trains on intersecting tracks.



NO. 499,943.—TROLLEY WIRE HANGER.

499,811. Telegraphy; Pierson J. Wicks, Brooklyn, N. Y. Application filed Mar. 3, 1893. In a quadruplex or duplex instrument, a relay at a receiving station, a second relay for recording signals due to changes in current strength, and a relay for directing main line currents to the second relay in either of the two directions of main line current.

499,848. Secondary Battery; F. O. Norton, Oroville, Cal. Application filed May 26, 1892. In a secondary battery, a cylindrical vessel closed at top and bottom, metallic battery discs or plates arranged within the top and bottom of the vessel and connected with the battery wires, a hydrated alkaline oxide within the cylinder in contact with one of the plates, and an anhydrous metallic substance adjacent to the hydrated oxide and contacting with the other metallic disc or plate.

499,852. Electric Converter; Gustav Pfannkuche, Exeter, N. H. Application filed May 13, 1887. In an electric converter the combination of a primary conductor with a tubular secondary conductor of magnetic material arranged to inclose the primary, whereby it constitutes a magnetic envelope or closed circuit for lines of force.

499,864. Electric Alarm Money Drawer; Wm. J. Walker and Alex. L. Bedford, St. Louis, Mo. Application filed Feb. 17, 1893. This invention comprises a drawer, suitable number plate, a rotatable handle having a suitable index, the index being normally opposite a certain number on the plate, a lug on the handle, a switch having suitable openings co-operating with the lug, the opening being normally opposite a different number on the number plate.

499,871. Trussed Trolley-Board for Electric Cars; Henry Cochran, Chester, Pa. Application filed Jan. 16, 1893. The combination with a pair of standards having perforations, of a trolley board having its ends terminating against the standards and a truss rod connecting the standards and provided with nuts.

499,908. Stand for Electric Lamps; Josef Cathrein, Innspruck, Austria-Hungary. Application filed Feb. 15, 1893. The combination with a portable stand for electric lamps, of an arm pivoted to the ceiling at or near the centre of the room, and a lead extending from the ceiling along the arm and connected to the portable lampstand.

499,916. Mode of and Means for Renewing the Filaments of Electric Incandescent Lamps; Gustav A. Frei, Springfield, Mass. Application filed Nov. 14, 1892. A temporary mount for the purpose herein set forth, consisting of a body of non-conducting material with two receivers for the joint tubes and a handle stem.

499,930. Electric Cut-out; O. F. Persson, Lynn, Mass. Application filed May 1, 1893. In a cut-out for electric circuits a pivoted handle and a notched impulse disc pivoted thereto combined with yielding pawls engaging the latter, a pair of circuit closing arms pivotally connected to the line wire, circuit closing and breaking contact pieces and links pivoted to the impulse disc and loosely connected to the circuit closing arms.

499,943. Trolley Wire Hanger; Lorenz Spillman, Columbus, O. Application filed Jan. 21, 1893. A trolley wire hanger or support having its lower part curled to form a tube open at its upper side to receive the wire, the tube being tapered at its ends so as to obtain an even or unbroken surface between the ends of the tube and the wire. (See illustration.)

499,964. Electric Bath Metal Heating Apparatus and Process; George D. Burton, Boston, and Edwin E. Angell, Somerville, Mass. Application filed Dec. 31, 1892. The combination of a nozzle, means for supplying a conductive fluid thereto, a workholder, and means for connecting the liquid and work with opposite electric poles.

500,022. Electric Road Vehicle; J. W. Moakler, Denver, Colo. Application filed April 16, 1892. The combination of a vehicle body having a battery, and a regulator with a switch, a worm fixed to the motor armature, a frame connected to the bottom of the vehicle body and sustaining the motor and worm, with a worm wheel and sprocket gears and belt. (See illustration.)

500,026. Electric Lighting System; Chas. L. Morey, Centralia, Ill. Application filed Feb. 11, 1893. A door attachment comprising a casing, an electric lamp set in the casing, and a push button for closing the circuit of the lamp.

500,027. Electric Bell; Wm. J. Murdock, Boston, Mass Application filed March 18, 1893. A magneto bell, comprising in its construction an electromagnet, a pivoted armature, a pivoted bell hammer, a contact terminal, and a strip of resilient material secured on the armature and forming a tongue which is connected with the bell-hammer and a tongue for contact with the contact terminal.

500,041. Electric Signal; G. W. Swartz, Florence, Ala. Application filed Oct. 31, 1892. The combination with a slide and bell crank lever for holding same pivoted at its elbow and one arm formed with a projection, of a magnet, its armature pivoted and arranged to engage the projection and a contact point for engaging the lever when the latter is disengaged from the armature.

500,045. Automatic Electric Weighing Scale; C. F Wood, Richmond, Va. Application filed Aug. 30, 1892. The combination with the electrical weighing scales having a movable receptacle and a bag holder, of a transfer funnel with a supporting lever and operating magnet connected with the weighing scales and operated by its circuit, and arranged to transfer the contents of the weighing receptacle.

500,053. Incandescent Electric Lamps; E. E. Cary, Boston, Mass. Application filed April 7, 1893. This consists of a glass globe having a neck, a fusible cement in the neck for rendering the globe airtight, and a silver coated reflecting disc adapted to prevent the radiant heat of the filament from softening the cement.

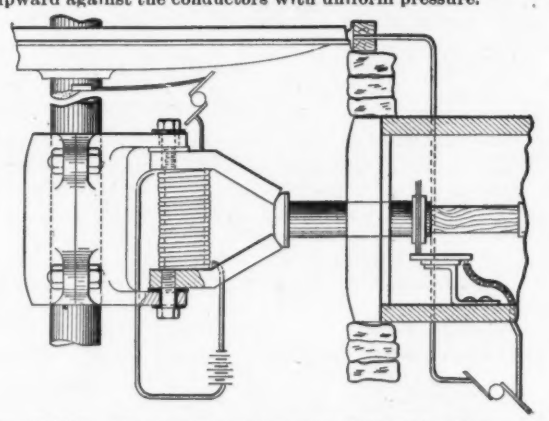
500,065. Closed Conduit for Electric Railways; John C. Henry, New York, N. Y. Application filed Sept. 8, 1890. In an electric railway, the combination of contact boxes at intervals along the roadway, an armature projecting through each box and a temporary magnet carried by the car adapted to raise said armatures above the surface of the street, and make magnetic and electric contact with them.

500,066. Electric Locomotive; J. Henry, New York. Application filed Oct. 18, 1890. The combination of the motor, its supporting sidebars, having bearing for the armature shaft and the crossbeam of non-magnetic material separating and supporting the magnet limbs from the sidebars.

500,067. Electric Locomotive; J. C. Henry, New York. Application filed Dec. 16, 1891. The combination of the axle, the sidebars pivoted thereon at one end, an armature mounted on and between the bars, a polepiece carried by the end of the bars distant from the axle and having a magnetizing coil, and a consequent polepiece mounted on the axle.

500,068. Electric Railway System; J. C. Henry, New York. Application filed April 29, 1892. In an electric railway system, in combination with a source of electricity, a plurality of motors connected therewith and an electric cut-out for one or more of the motors, comprising an electromagnetic switch adapted to be operated by a variation of current between the motor terminals to open and leave open the circuit of the motor.

500,070. Electric Railway Trolley; J. C. Henry, Westfield, N. J. Application filed Sept. 3, 1890. In an electric railway having overhead conductors, the combination with a motor car of a collector and a fusee and spring by which it is pressed upward against the conductors with uniform pressure.



NO. 500,065.—CLOSED CONDUIT FOR ELECTRIC RAILWAYS.

500,075. Incandescent Electric Lamp; Wm. E. Nickerson, Cambridge, Mass. Application filed April 1, 1893. In an incandescent electric lamp a fusible cement supporting the leading-in wires and rendering the lamp airtight, composed of a granular substance, as sand, and a fusible matrix.

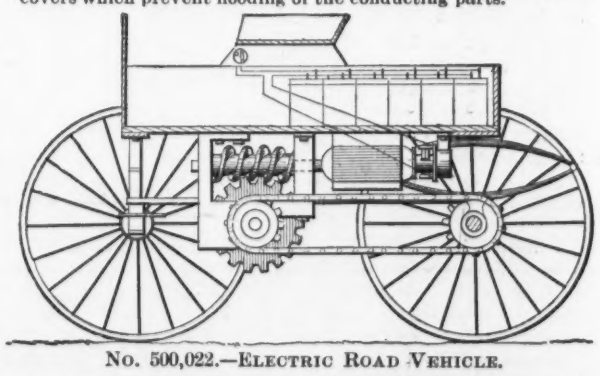
500,076. Incandescent Electric Lamp; W. E. Nickerson, Cambridge, Mass. Application filed April 3, 1893. In an incandescent electric lamp the combination of a glass globe, a disc, cement plug, filament, leading-in wires having bends adapted to support the wires.

500,077. Incandescent Electric Lamp; W. E. Nickerson, Cambridge, and E. E. Cary, Boston, Mass. Application filed April 5, 1893. An incandescent lamp with glass, disc, cement plug and filament; leading-in wires having convolutions between the filament and cement plug.

500,078. Incandescent Electric Lamp; W. E. Nickerson, Cambridge, Mass. Application filed April 5, 1893. The combination of glass globe, a filament and leading-in wires, cement plug and disc with filling of sand.

500,079. Incandescent Electric Lamp; W. E. Nickerson, Cambridge, Mass. A glass globe, with disc and cement plug, a filament with leading-in wires, the wires being flattened.

500,104. Electric Railway System; C. J. Reed, Orange, N. J. Application filed June 27, 1892. This consists of a series of vertically pivoted switching devices having insulated journals provided with angular conducting arms and protecting cups or covers which prevent flooding of the conducting parts.



NO. 500,022.—ELECTRIC ROAD VEHICLE.

499,921. Electric Stop Mechanism for Knitting Machines; Frank Hammond, Paris, Canada. Application filed Jan. 9, 1893. A rod located in proximity to the belt-shifting lever and provided with a head to act as a brake upon the driving pulley, a spring arranged to impart longitudinal motion to the rod, a finger connected to rod and projecting behind the belt-shifting lever to a point where it engages with a pivoted lever when the spring is compressed in combination with electrical means for disengaging the pivoted lever.

499,879. Phonograph; T. A. Edison, Llewellyn Park, N. J. Application filed July 30, 1888. In a phonograph, the combination with the rocking holding arm and the traveler arm, of the turning lifting bar acting upon both of the arms and the foot treadle connected with the turning lifting bar for operating it.